THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LX. No. 1546.] LONDON, DECEMBER 27, 1892. [44TH YEAR. PRICE 6d.

GAS AND WATER PIPES

1¼ to 12 IN. BORE.

THOMAS ALLAN & SONS,

Bon Lea Foundry,

SOUTH STOCKTON-ON-TEES.

ALSO MANUFACTURERS OF

SANITARY & RAIN-WATER PIPES, HOT WATER PIPES, STABLE FITTINGS, RANGES, STOVES, And GENERAL CASTINGS.

GLASGOW OFFICE: 24, GEORGE SQUARE.

Telegrams:

"BONLEA, STOCKTON-ON-TEES."

"SPRINGBANK, GLASGOW."

— ESTABLISHED 1830. —

PARKER & LESTER,

Manufacturers & Contractors.

THE ONLY MAKERS OF

PATENT ANTIMONY PAINT,

Parker's Imperial Black Varnish,

Oxide Paints, Oils, and General Stores for Gas and Water Works.

WORKS:

ORMSIDE STREET, OLD KENT ROAD, LONDON.

WOLSTON'S

TORBAY PAINTS

Special Quotations to Gas Companies.

DARTMOUTH, DEVON.

Lanemark Coal Co.,

LIMITED.

LANEMARK CANNEL

AND GAS COALS.

Quotations and Analysis on application to

LANEMARK COLLIERY,

NEW CUMNOCK, N.B.

Shipping Ports: All the principal Scotch Ports.

GASHOLDERS

C. & W. WALKER

Have completed a four-lift Holder nearly 200 feet high, of about 8 MILLION cubic feet, at the Beckton Gas-Works, London.

PURIFIERS. SULPHATE PLANT.

Weck's Centre-Valve.

CLAUS' SULPHUR-RECOVERY PLANT.

PURIFYING MACHINES.

ADDRESSES:

MIDLAND IRON-WORKS, DONNINGTON, NEAR NEWPORT, SHROPSHIRE;

10, Finsbury Square, London.

"FORTRESS DONNINGTON." "FORTRESS LONDON."—Telegraphic.

SAWER AND PURVES,

LATE

FLETCHER AND MURPHY,

GARRATT STREET WORKS, OLDHAM ROAD, MANCHESTER,

Manufacturers of

IMPROVED CONSUMERS' WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

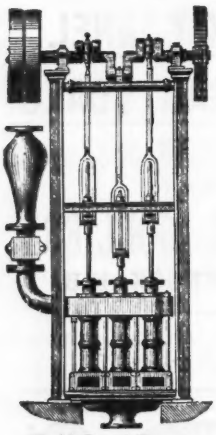
AND

IMPROVED DRY GAS-METERS.

SPECIALITY: PATENT CASH PREPAYMENT METERS.

STEAM & HAND PUMPS FOR GAS-WORKS,

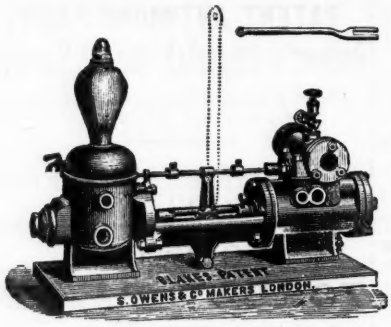
FOR PUMPING TAR, WATER, AND LIQUOR.



Treble-Barrel Pumps in Frame.

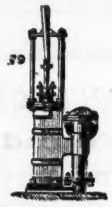
Syphon Pump.

Double-Barrel Force-Pump in Frame.



BLAKE'S PATENT STEAM PUMPS.

20,000 IN USE.



Improved Double Action Pump.

Cast-Iron Hand-Pump.

Wrought-Iron Portable Pump.

S. OWENS & CO., Hydraulic, Gas, & General Engineers, WHITEFRIARS ST., LONDON, E.C.

SOLE MANUFACTURERS OF

MANN & OWENS' PATENT SCREW & CAM, also FULL-WAY RACK & PINION GAS-VALVES.

S. O. and Co.'s New Catalogue of Gas Apparatus and General Machinery can be had on application.

NEWTON, CHAMBERS, & CO., LIMITED,

THORNCLIFFE IRON-WORKS, near SHEFFIELD,

MANUFACTURERS OF

SLIDE VALVES, WITH RACK & PINION OR Internal or External SCREWS, of all Sizes.

GASHOLDERS, AND Gasholder Tanks.

CAST-IRON RETORTS,

RETORT-BED FITTINGS,

And Retort-House Appliances

of every description.

Iron Roofs, Columns, Girders, Floor Plates and Tools, &c.

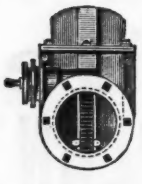
WROUGHT AND CAST IRON CONDENSERS, SCRUBBERS, & WASHERS,

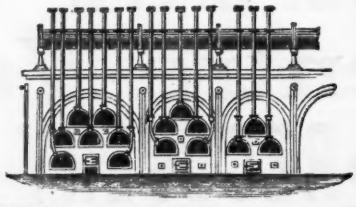
TAR AND LIQUOR PUMPS, &c.

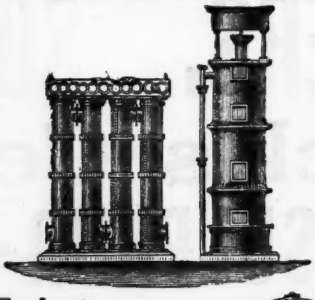
PATENT CENTRE VALVES

for working Purifiers.

Also Bye-Pass & Stop Valves.





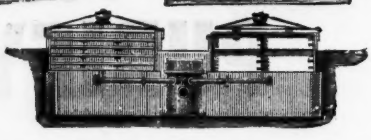


PURIFIERS with Planed Joints,

HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS and SPECIALS,

WOOD GRIDS.

CAST AND WROUGHT IRON TANKS AND CISTERNS.



DESIGNS, SPECIFICATIONS, AND ESTIMATES FREE.

Pig Iron (*Special Quality*) for ENGINE CYLINDERS, &c.

GAS COAL FAMOUS FOR ITS UNRIVALLED EXCELLENCE.

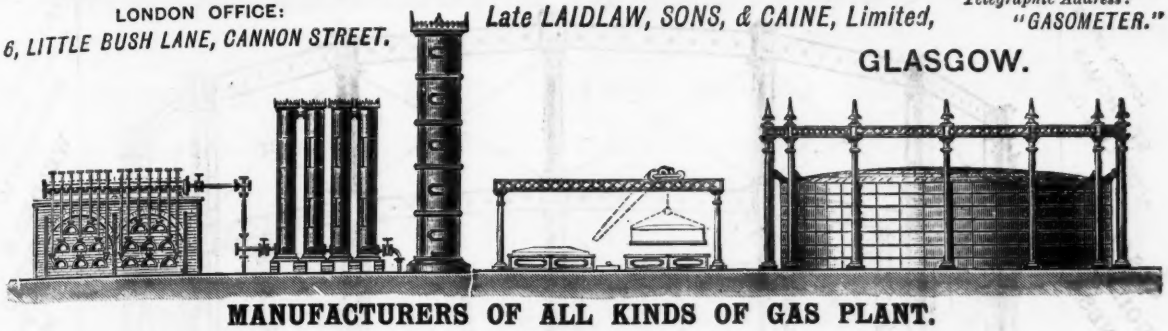
THE BARROWFIELD IRON-WORKS, LIMITED,

LONDON OFFICE:
6, LITTLE BUSH LANE, CANNON STREET.

Late LAIDLAW, SONS, & CAINE, Limited,

Telegraphic Address:
"GASOMETER."

GLASGOW.



MANUFACTURERS OF ALL KINDS OF GAS PLANT.

RETORT-BENCH FITTINGS; SIEMENS'S REGENERATIVE AND ORDINARY FURNACES;
CONDENSERS, EXHAUSTERS, AND ENGINES; SCRUBBERS, WASHERS;
PURIFIERS, WITH PLANED AND CEMENT JOINTS;
DRY AND HYDRAULIC CENTRE-VALVES;
HYDRAULIC AND HAND-POWER LIFTING APPARATUS;
GASHOLDERS, SINGLE-LIFT & TELESCOPE; CAST & WROUGHT IRON TANKS;
STATION METERS; GOVERNORS; SCREW AND RACK VALVES;
FOUR-WAY COCKS AND HYDRAULIC VALVES;
CAST-IRON GAS, WATER, & STEAM PIPES & CONNECTIONS; WROUGHT-IRON TUBES & FITTINGS;
IRON ROOFING, MARKET BUILDINGS, BRIDGES, GIRDERS, STEAM BOILERS;
PROMENADE PIERS AND LOADING WHARVES.

MANUFACTURERS OF OIL PLANT OF EVERY DESCRIPTION.

HENDERSON'S Patent Retorts, Condensers, Stills, Cast and Wrought Iron Tanks, Ammonia Stills, Wrought-Iron Gas-Mains, &c., &c.

DESCRIPTIVE SPECIFICATIONS AND ESTIMATES ON APPLICATION.

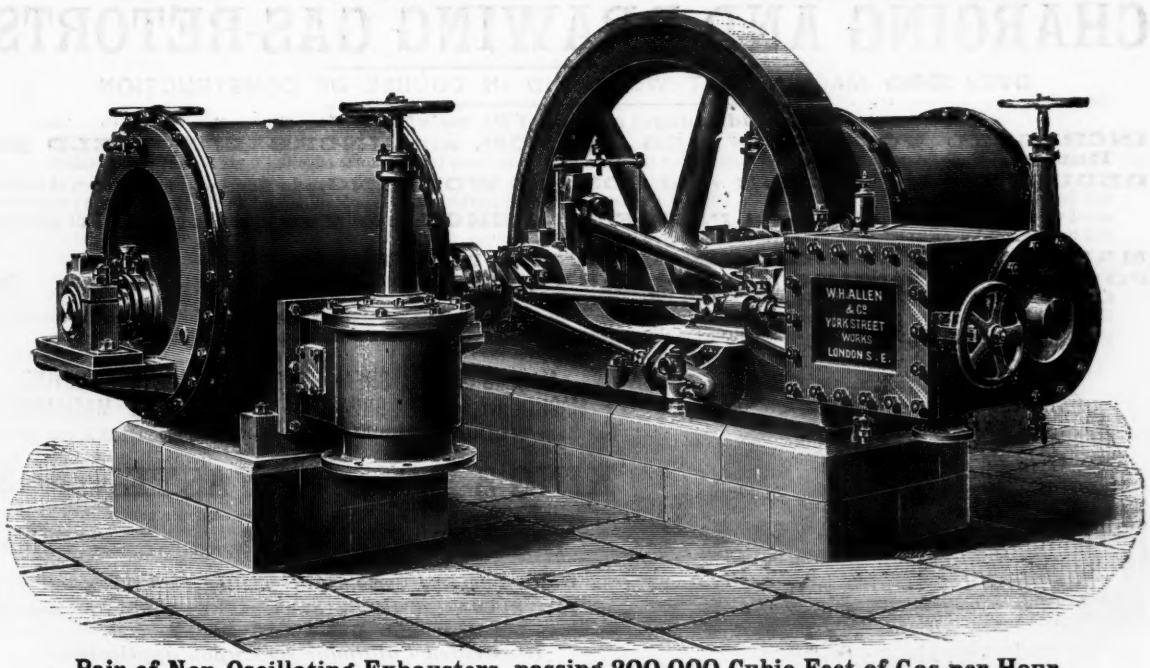
W. H. ALLEN & CO.,

York Street Works, LAMBETH, LONDON, S.E.,

MAKERS OF THE MOST IMPROVED FORM OF

GAS EXHAUSTING MACHINERY.

BEALE'S PATENT—ALLEN'S COMBINED SYSTEM.

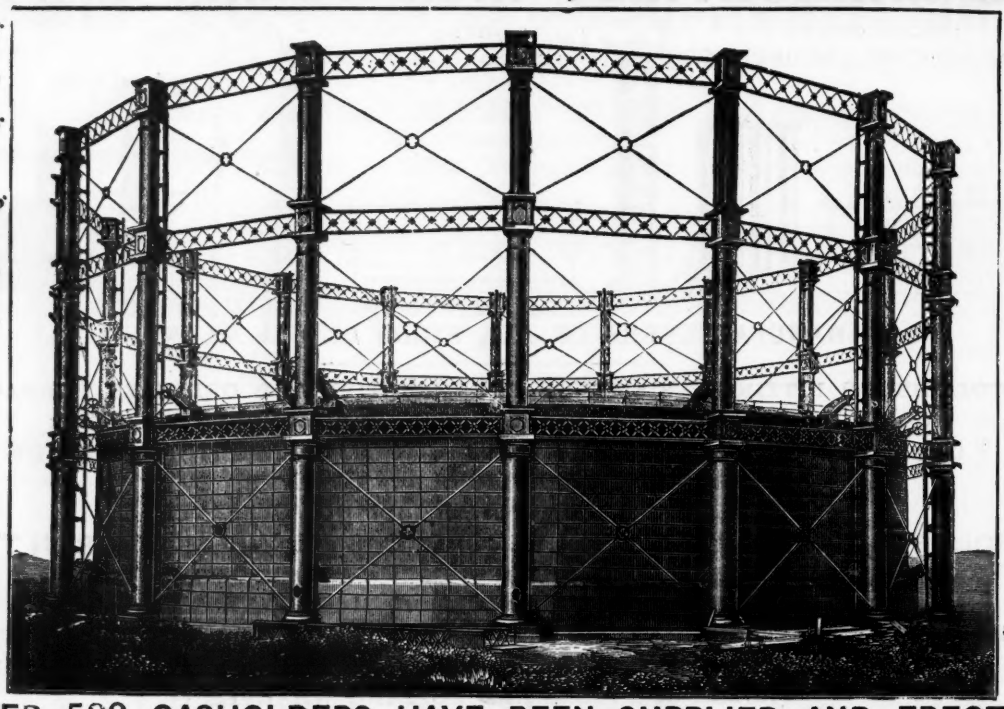


Pair of Non-Oscillating Exhausters, passing 200,000 Cubic Feet of Gas per Hour.

THOMAS PIGGOTT & CO., LTD., BIRMINGHAM.

LONDON OFFICE: ST. THOMAS APOSTLE, E.C.

GAS PLANTS, BOILERS, ENGINES, PUMPS, ROOFS RETORT FITTINGS, ETC.



TELEGRAPHIC ADDRESS: ATLAS, BIRMINGHAM.

WELDED & RIVETED PIPES, FOUL MAINS, RETORT-LIDS, & CAST TANKS, PURIFIERS.

OVER 500 GASHOLDERS HAVE BEEN SUPPLIED AND ERECTED.

INCLUDING THOSE SUPPLIED TO THE FOLLOWING GAS COMPANIES AND CORPORATIONS:

BATH.	BOLTON.	BRISTOL.	CHELTENHAM.	LEAMINGTON.	PRESTON.	SHEFFIELD.
BELFAST.	BOMBAY.	BRISBANE.	HARTLEPOOL.	LIVERPOOL.	READING.	STOCKHOLM.
BECKTON.	BRADFORD.	CARDIFF.	LEEDS.	NOTTINGHAM.	RIO GRANDE.	SYDNEY.
BIRMINGHAM.	BRIGHTON.	COVENTRY.	LEICESTER.	OLDHAM.	SOUTH METRON.	VIENNA.

WEST'S GAS IMPROVEMENT Co., Ltd.,

Engineers, Ironfounders, & Contractors,

ALBION IRON-WORKS, MILES PLATTING, MANCHESTER.

MANUFACTURERS OF

WEST'S PATENTED MACHINERY

FOR

CHARGING AND DRAWING GAS-RETORTS

OVER **240** MACHINES AT WORK AND IN COURSE OF CONSTRUCTION.

Advantages attending its use are:

INCREASED VOLUME of GAS per TON, and INCREASED YIELD per Retort.—The system of breaking and distributing the coals in an even layer in the retorts effecting more perfect carbonization.

REDUCTION in LABOUR and COST of WORKING.—In Works where this System of charging and drawing Retorts is adopted, there has been effected a substantial saving in the cost of Gas Manufacture in the Retort-House; the amount saved varying in different Gas-Works from **8 PENCE** to **15 PENCE per Ton** of coal carbonized. Full particulars will be forwarded upon application to W. G. I. Company, Limited.

MANUAL CHARGING AND DRAWING MACHINES.

POWER CHARGING AND DRAWING MACHINES, driven by COMPRESSED AIR, STEAM, or ROPE. The power machines are applicable to circular, oval, or Ω-shaped retorts and mouthpieces, and are the most perfect, economical, efficient, and durable machines made. They are constructed on principles founded by long and extensive experience in this special branch of gas engineering and the manufacture of gas.

MAKERS OF COAL BREAKING, ELEVATING, AND CONVEYING MACHINERY, COKE BREAKING AND WASHING MACHINERY.

Sole Makers of CIRCULAR, OVAL, or Ω-shaped **MOUTHPIECES** with Morton's Self-Sealing Lids, fitted with

KING'S PATENT FASTENINGS,

secure a very tight joint; and at the same time the eccentric motion given to the Lid effectually removes the Tar from the surfaces of the Joint.

N.B.—The whole of these Fittings are made of Wrought Iron. Several Thousands in use.

West's Improved Combined Regulating Liquor Seal Valve.

OXIDE ELEVATING MACHINERY, COKE BARROWS, VALVES, AND ALL GAS-WORKS PLANT, &c.

Illustrated Catalogue sent upon application.

Mr. JOHN WEST, M.Inst.C.E. *Managing Director.*

THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

MIDLAND DISTRICT OFFICE: 22, TEMPLE ST., BIRMINGHAM—SOLE AGENT: A. C. SCRIVENER.

TELEGRAPHIC ADDRESS: "WIGAN BIRMINGHAM." TELEPHONE No. 200.

LONDON DISTRICT OFFICE: 6, STRAND, LONDON—C. PARKER & SON, SOLE AGENTS.

TELEGRAPHIC ADDRESS: "PARKER LONDON."

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S PATENTS

All Spent Limes are most effectually, economically, and continuously recovered, and at from one-third to one-half the cost of New Lime. The results are a surprise to all who have inspected the process, and are entirely satisfactory to all now using it. Descriptive Pamphlet and Terms from Agents as under.

— REGENERATIVE SETTINGS OF RETORTS. —

Hislop's Patent Producer and Patent Charging Appliances offer advantages which are unapproachable; while in every other detail his Settings are confidently recommended as being the most inexpensive and effective possible.

Illustrated Pamphlet and Terms on application to J. E. FISHER, Stourbridge, Agent for England and Wales; to C. M. HAMILTON, Portland Place, Hamilton, Agent for Scotland and Ireland; and for all other Countries to the Patentee,

Geo. R. HISLOP, Gas Engineer, PAISLEY, N.B.

INCLINED RETORTS,

FIRE BRICKS, LUMPS, TILES, BLOCKS, &c.

Special Bricks for Intense Heats.

GAS RETORTS.

CASTINGS AND EVERY REQUISITE FOR GAS-WORKS.

MOBBERLEY & PERRY,

Fire-Brick Works, STOURBRIDGE.

☞ **Retort Setters sent to any part of the Kingdom.**

IMPORTANT TO ENGINEERS AND GAS COMPANIES.

A NEW CARBURETTOR FOR ENRICHING GAS IN BULK.

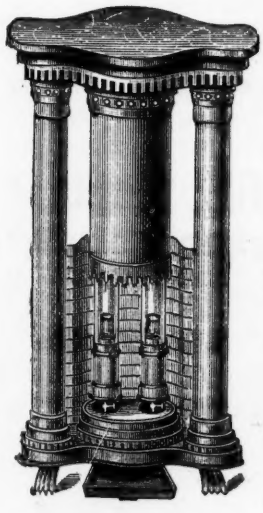
The Carburettors have been doing practical work for the past two years; in many cases doing all the enrichment without the use of Cannel or other rich Coals. The South Metropolitan Gas Company have these Enrichers at all their Stations. The Gaslight and Coke Company have had them in use at some of their principal Works for two years past; and several more are now being fixed at their other Stations. The Carburettors are also in use at several Suburban and Provincial Gas Companies' Works.

FOR PRICES AND FULL PARTICULARS, APPLY TO

THE GAS LIGHTING IMPROVEMENT COMPANY, LIMITED,

(FRANK W. CLARK, Engineer and Manager)

18, DEVONSHIRE STREET, BISHOPSGATE, LONDON.



THE "SYPHON" (REGISTERED TITLE.)

(CLARK'S PATENT.)

Hygienic Gas Heating-Stoves

For Use Without a Flue.

NO FLUE REQUIRED. NO SMOKE. NO SMELL.
NO DIRT OR TROUBLE. NO DANGER.

All Sulphurous Vapours are condensed inside the Stoves, and passed off as liquid into the tray beneath.

The "SYPHON" Hygienic Gas Heating-Stoves give a pure, equable, and agreeable heat, which can be graduated and sustained at the will of the user. They are so constructed that a moist or dry atmosphere is obtained at pleasure.

They are the Only Safe Stoves for use in Greenhouses, Conservatories, Bed-rooms, &c., and especially suitable for Halls, Sitting-Rooms, Offices, Shops, Schoolrooms, and Theatres.

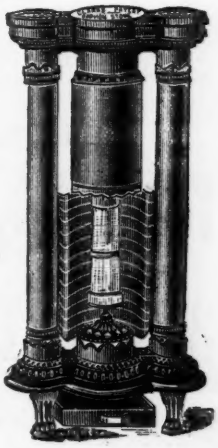
Adopted by the principal Gas Companies throughout the Kingdom.

Illustrated Price Lists on application to

S. CLARK & CO., Patentees and Makers,

Syphon Works, Park Street, Islington, London, N.

Telegraphic Address: "Syphon Stoves, London."



KIRKHAM, HULETT, & CHANDLER,

LIMITED.

(SIDNEY HERSEY, Managing Director.) (J. CHANDLER, Engineer.)

PATENT

"STANDARD" WASHER-SCRUBBER.

456

of these Machines (capable of dealing with 436,345,000 cubic feet of Gas daily) erected and in course of construction. These facts are given as evidence of the apparatus being the most efficient of any in the market for the extraction of

AMMONIA, CARBONIC ACID, AND SULPHURETTED HYDROGEN FROM COAL GAS.

70 of the above Machines have been constructed according to the Company's latest Patent, which has also been applied to 41 original pattern Machines.

TESTIMONIALS.

The Gaslight and Coke Company,
Horseferry Road, Westminster, S.W.,
Nov. 25, 1889.

Messrs. KIRKHAM, HULETT, AND CHANDLER, LTD.,
Gentlemen,

In reply to your inquiry respecting the result of putting Wooden "Bundles" into some of the Washer-Scrubbers at our Beckton Station, I beg to say they have answered admirably for the few months they have been in; and I think them a decided success.

I am, yours truly,
(Signed) G. C. TREWBY.

NOTE.—Orders since received for four 3,500,000 cubic feet per day Machines for Beckton; and two 3,000,000 cubic feet for Kensal Green, &c., &c.

Extract from the JOURNAL OF GAS LIGHTING, &c., for Sept. 27, 1892, referring to the visit of the Members of the Eastern Counties Gas Managers' Association to the Lowestoft Gas-Works—

"Mr. J. Ayris has one of Messrs. Kirkham, Hulett, and Chandler's "Standard" Washer-Scrubbers in operation (capable of dealing with 500,000 cubic feet of gas per 24 hours); and of the working of this machine he spoke very highly."

Estimates furnished for cost of altering original pattern Patent "Standard" Washer-Scrubbers, or for the supply of New Machines.

ADDRESS:—

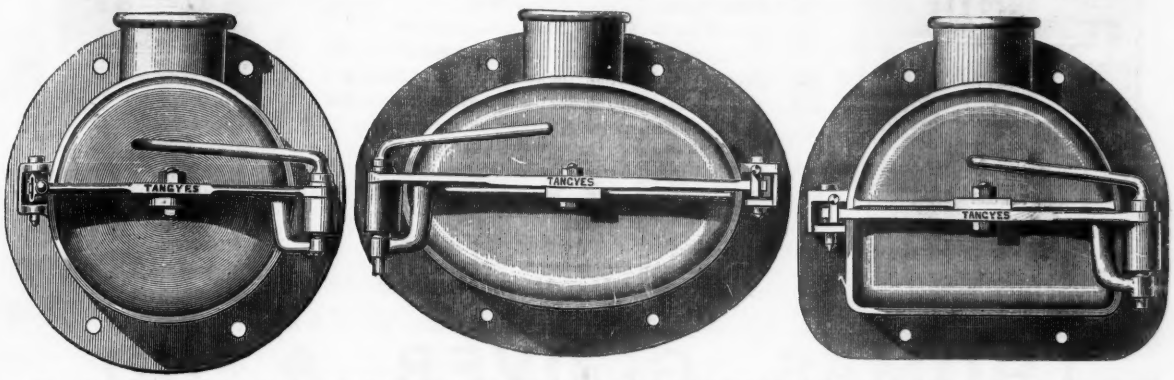
3 & 4, PALACE CHAMBERS, BRIDGE STREET, WESTMINSTER, S.W.

TANGYES LIMITED, CORNWALL WORKS, BIRMINGHAM.

AND AT LONDON, NEWCASTLE, MANCHESTER, GLASGOW, SYDNEY, MELBOURNE, JOHANNESBURG, GENOA, BILBAO, & ROTTERDAM.

MORTON'S SELF-SEALING RETORT-LID,

With Holman's Anti-Friction Catch, Self-Sustaining Cross-Bar, and Improved Eccentric Bolt.



These Retort Lids and Fastenings are made in three forms, round, oval, and ⏍ (as shown above), in each of which we have a very extensive variety of patterns, from which Gas Engineers contemplating the adoption of these Lids are recommended to make their selection, in order to avoid cost of pattern-making, delays, &c., &c.

QUOTATIONS WILL BE GIVEN ON RECEIPT OF PARTICULARS OF REQUIREMENTS.

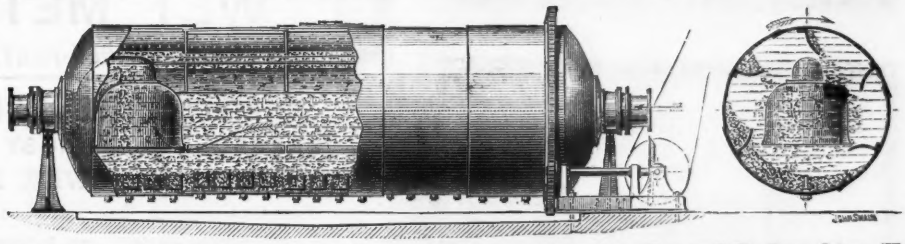
LIST OF PATTERNS ON APPLICATION.

Telegrams: "TANGYES, BIRMINGHAM." No. 90 E.

WATER PURIFICATION.

RIVER WATER and SEWAGE EFFLUENT successfully and economically treated in large volumes, by AGITATION WITH METALLIC IRON in

ANDERSON'S PATENT REVOLVING PURIFIER.



No Choking of Filter-Beds.
Colour due to Peat and Clay entirely Removed.
Simple & Rapid in its Action.
Organic Matter Considerably Reduced.
Microbes Totally Removed.

Made in Fourteen Sizes, capable of treating singly from 4000 to 1¼ Million Gallons daily.

REVOLVING PURIFIER COMPANY, LIMITED,

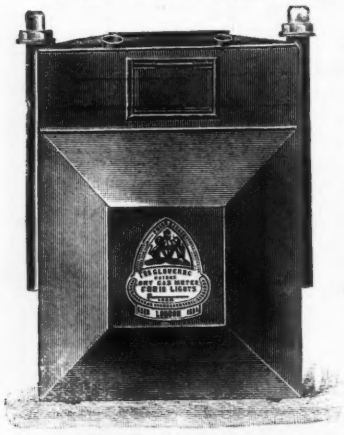
DOCK HOUSE, BILLITER STREET, LONDON, E.C.

[ESTABLISHED 1844.] **ORIGINAL MAKERS.** [ESTABLISHED 1844.]

LONDON, 1851. NEW YORK, 1853. PARIS, 1855. LONDON, 1862. DUBLIN, 1865. PARIS, 1867.

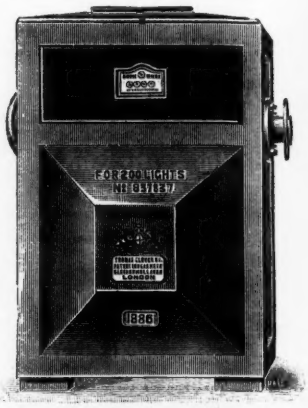
THE SIX MEDALS AWARDED TO THOMAS GLOVER'S PATENT DRY GAS-METERS:

The latter being the Highest Award for Dry Gas-Meters at the Paris Exhibition, 1867. Since then we have not Exhibited FOR PRIZES.



1st.—Are a remedy for all the defects of Wet Meters.
2nd.—Are suitable for all Climates, whether hot or cold.
3rd.—Incur no loss of Gas by Evaporation.
4th.—Cannot become fixed by Frost, however severe.
5th.—Are the most accurate and unvarying measurers of Gas.
6th.—Prevent jumping or unexpected extinction of the Lights.
7th.—May be fixed either above or below the level of the Lights.
8th.—Cannot be tampered with without visibly damaging the outer case.
9th.—Will last much longer than Wet Meters.
10th.—Will not cost more than one-half for repair that Wet or Water Meters do.

Are upheld for five years without charge.



Telegraphic Address: "GOTHIC LONDON."
Telephone No. 6725.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 to 222, ST. JOHN ST., CLERKENWELL GREEN, LONDON, E.C.

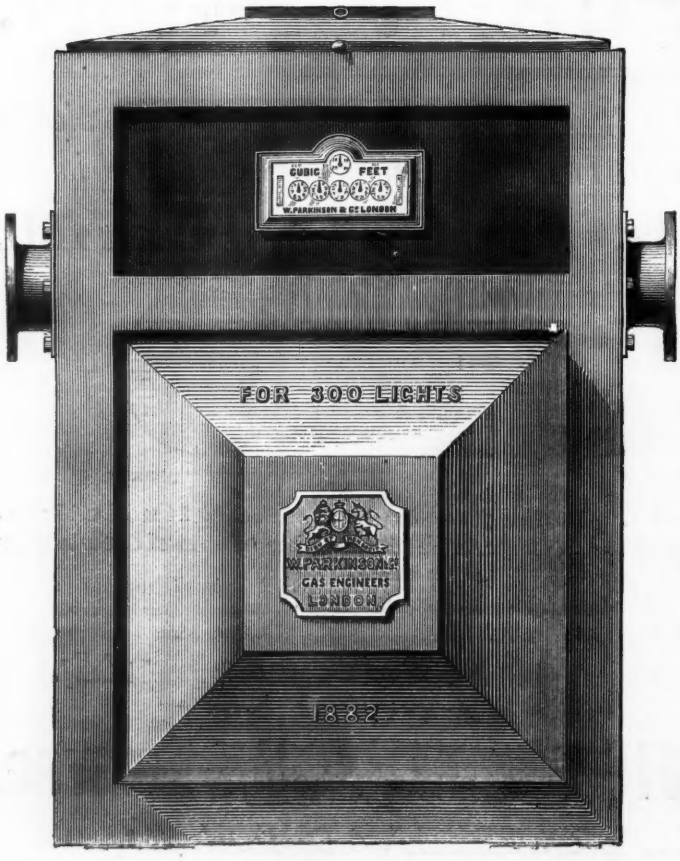
BRISTOL: 62, VICTORIA STREET. *Telegraphic Address*: "GOTHIC."

BIRMINGHAM: 3, BRIDGE ROW, DERITEND. *Telegraphic Address*: "GOTHIC."

LEEDS BOAR LANE CHAMBERS, 4, BASINGHALL STREET. *Telegraphic Address*: "GOTHIC."

MANCHESTER: 37, BLACKFRIARS STREET. *Telegraphic Address*: "GOTHIC."

W. PARKINSON & Co.



MANUFACTURERS OF

DRY METERS

OF THE VERY BEST QUALITY.

The **DIAPHRAGMS** are of the Finest PERSIAN SHEEP SKINS.

The **CASES** are of the Best CHARCOAL-TINNED PLATES.

WET METERS,

With PATENT THREE-PARTITION DRUMS.

STATION METERS AND GOVERNORS,
PRESSURE & EXHAUST REGISTERS,
MOTIVE POWER METERS,
Test Gasholders, Experimental Apparatus, &c.
PRESSURE GAUGES OF EVERY DESCRIPTION.

NEW ILLUSTRATED CATALOGUE & PRICE LIST
Sent post free on application.

COTTAGE LANE WORKS, CITY ROAD,
LONDON.
Telegraphic Address: "INDEX."

BELL BARN ROAD WORKS, **BIRMINGHAM.** Telegraphic Address: "GAS-METERS."

OFFICE: 10, MAWSON'S CHAMBERS, DEANSGATE, **MANCHESTER.** Telegraphic Address: "PRECISION."

[See also Advt., p. 1148.

CONTENTS.

EDITORIAL NOTES:—

GAS, LIGHTING, &c.— PAGE

1892.—A Retrospect of the Year 1117

WATER AND SANITARY AFFAIRS—

The Principal Events of the Year 1892 1120

ESSAYS, COMMENTARIES, AND REVIEWS:—

Gas and Water Companies in the Stock Market 1122

A Study in Industrial Competition 1122

American Views on Gas Managers' Associations 1122

COMMUNICATED ARTICLES:—

The Edison Lamp Decision. By Our American Correspondent . . . 1124

Coal Gas: Its Manufacture, Distribution, and Consumption—Thirteenth Article 1125

TECHNICAL RECORD:—

The Theory of the Modern Gas-Engine 1127

Otto's Patent Aerial Ropeways 1127

The Behaviour of Ethylene on Explosion with Less than its Own Volume of Oxygen 1127

The Luminosity of Coal-Gas Flames 1129

REGISTER OF PATENTS:—

Portable Gas-Fire Stove—Bell, G. M. 1129

Gas and Hydrocarbon Engines—Seck, W. 1129

Regulating the Pressure of Gas and other Fluids—Strathern, A. M. & A. G. 1129

Gas Furnaces—Newton, H. E. (Oakman, R. N.) 1130

Gas Producing Plant—Oakman, R. N. 1130

Gas Engines—Simon, R. 1131

Gas Engines and Motors—Redfern, G. F. (La Societe Anonyme des Moteurs Thermiques Gardie) 1131

Patent Notices 1131

LEGAL INTELLIGENCE:—

Supreme Court of Judicature—Court of Appeal—London County Council, Appellants, *v.* Assessment Committee of the Woolwich Union, Respondents; Same *v.* Assessment Committee of St. George's Union, Respondents 1131

High Court of Justice—

Chancery Division—*In re* Buenos Water Supply and Drainage Company, Limited 1131

Queen's Bench Division—The Local Government Board *v.* Staines Board of Guardians 1132

MISCELLANEOUS:—

The Failure of the Electric Light in the City 1132

The Electric Lighting Muddle at Windsor 1132

The Electric Lighting Question at Taunton—Board of Trade Inquiry . . 1132

The Stourbridge Improvement Commissioners and the Gas-Works . . . 1134

A Hundred Years of Gas Lighting 1134

The Metropolitan Water Supply Commission—Twenty-sixth Day . . . 1135

Metropolis Water Supply—The Quality of the Water in November . . . 1137

Stockton and Middlesbrough Water Board—Half-Yearly Report; The Charge for Water for Manufacturing Purposes 1137

Notes from Scotland 1138

Current Sales of Gas Products 1139

Coal Trade Reports 1139

Gas and Water Companies' Stock and Share List 1139

PARAGRAPHS.—Forthcoming Private Bill Legislation, 1121—Professor Lewes on the Inventor of the Regenerative Burner, 1121—Italian Lignite, 1123—Mr. William Ewart, of Annan, 1126—New Use for Ammoniacal Liquor, 1126—Books Received, 1126—The Deimel Gas-Lamp, 1127—The Expansion of Liquids and Gases, 1129—The Loss of Head of Water Flowing in Cast-Iron Pipes, 1129—Extensions at the Conway Gas-Works, 1133—A New Water Scheme for Gainsborough, 1133—The Arbitration between the Richmond Gas Company and the Corporation, 1134—Bilston Gas Company, 1134—Roystone Water Supply, 1139—Sales of Shares, 1139—The Gas Difficulty at Accrington, 1139—An Electric Lighting Offer for Singapore, 1140—The Purchase of the Rhyl Gas-Works by the Local Authority, 1140—New Water Supply for Teignmouth, 1140—The Water-Works Purchase Question at Chatham, 1140.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

Telegraphic Address: "GASKING LONDON."

Telephone Number: 2789.

THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, DECEMBER 27, 1892.

1892.

A Retrospect of the Year.

ONCE more the course of time has brought round the season when men with one consent call a halt in the ordinary business of their lives, for the purpose of passing in review the experiences through which they have been led to the positions which they find themselves actually occupying in this transitory world. We do not need a deep dip into philosophy to become aware of the truth that the conventional divisions of time have no real connection with the working of human affairs; and that, in point of fact, Old Years end and New Years begin with every moment of our conscious lives. But there is a vast difference between understanding the truth of a matter upon an inquiry into it, and having the recognition of it forced upon us from without. And therefore, much as we owe to the calendar, perhaps the greatest of our obligations to it has reference to the circumstance that the necessity under which we lie, at this period, of putting away the old and procuring a new almanac, suggests with irresistible force that "backward glance" which sages of all eras have counselled as being at once the truest and the easiest way of gaining wisdom.

In turning over the pages of the volumes of the JOURNAL devoted to recording the condition of the gas industry during the year which is so nearly ended, the first thing that strikes one is the great and growing bulk of the printed matter that a most jealous editing has been compelled to include among the current literature of this important national industry. The gas supply of modern communities touches the outer world at so many points, and it comprises so wide a domain within its own borders, that our printed volumes grow ever bulkier, notwithstanding all endeavours to compress them within convenient limits. This patent fact is a very striking proof of the vitality and progressive development of the industry of which the JOURNAL is an appanage. When it is said that an industry is living and growing, however, it by no means follows that it is exempt from internal troubles and external accidents. Indeed, when an art or a manufacture is so firmly established in a community as to have become part of its structure, it unavoidably partakes of every vicissitude of the life of the community. Gas has to be made and supplied in modern towns, come fair, come foul, come good seasons or bad. The gas manufacturer cannot observe times and seasons in the pursuit of his occupation; and therefore he is in the way of feeling an infinite variety of influences which either affect differently or altogether pass over the mere trader, who can enlarge his connection or shut up shop according to the condition of his own particular line of commerce.

During the past twelve months the United Kingdom has experienced much financial, industrial, and commercial unrest, which has necessarily had its effects upon the national industry of gas supply. People who never thought of such matters before have had their attention directed to problems of currency, free trade, and cognate subjects; and the accepted bases of finance and commerce have been discussed as though these needed re-settlement in some particulars. Much of this new discussion of first principles has been due to the rise into prominence of a fresh element in national politics—the party, so called, of Labour. A number of noisy men have been encouraged by a certain section of the newspaper press to propound questions in industrial organization which were once generally regarded as answerable according to the accepted principles of Political Economy; but these men, having no knowledge of such principles, have treated them as non-existent. They have gone further than mere discussion of their favourite problems, and have essayed various experiments with a view to procuring a solution of them after their own desires; and consequently the past year has witnessed several interesting struggles of sections of the community against forces created by the collective operations of the community as a whole. Among these revolts are to be numbered the abortive strikes of the Northern and North Midland coal miners and the Tyne-side engineers. The two former movements, of course, directly affected the gas industry; and they exhibited the remarkable results of rendering gas coal dear, while the men who most wished to bring about this very effect—the miners—did not derive any benefit from the advance in price.

Dear coal, becoming cheaper, however, as the year wore on, has been the governing factor in the problem of economical gas-works administration during the past twelve months. In London and many other places, the selling price of gas has been advanced in consequence of the costliness of coal; and a good deal of acrimonious discussion has arisen upon this subject. Several large Gas Companies submitted to serious depletion of their reserve funds before taking the unpopular step of raising their price, and so establishing an equilibrium in their revenue accounts by main force. One of the principal sufferers from the strained conditions under which the gas industry was placed during the early part of the year was The Gaslight and Coke Company, whose ordinary "A" stock, which in January stood at 221-226, fell by May to 202-207. It has since recovered; but the drop is significant. One of the incidents of the year was the impeachment of the Board of the Company for mismanagement, by Sir Frederick T. Mappin, M.P., Chairman of the Sheffield United Gas Company, and the lively controversy respecting methods of trading in gas-works residuals which grew out of this affair. Not only has the British gas manager been plagued with

dear coal; but he has also seen the residuals market go to pieces before his shrinking gaze. Last winter was a mild one, and naturally coke accumulated in the works. Tar became almost unsaleable, in consequence of the low values ruling for anthracene and benzol. Sulphate of ammonia also fell to the lowest prices ever recorded against this commodity. The disputations that grew out of this state of affairs are attributable to intelligible leanings of opinion, which may be traced to the following lines of reasoning: Starting with the fact of coal at a good price, the natural question would be as to why the products of coal did not also command a fair value; and it certainly appears unaccountable that, at a time when Gas Companies were hardly able to procure coal fit for their purposes at any price, the residual products of coal should go begging for a purchaser. The consequence of the latter circumstance was that every fraction of the increased cost of the coal came upon the gas—an unprecedented result. Resting upon this awkward fact, some people argued that the residuals market must have been spoilt by bad management on somebody's part; and it was only a step to fix the blame for such misconduct upon those who dominated the residuals trade—viz., The Gaslight and Coke Company. Matters were a little mended for the Metropolitan Gas Companies during the autumn, by the absorption of their coke stocks; but this movement was not universal.

Notwithstanding the existence of disturbing influences of various kinds, money was cheaply raised for gas purposes during the past year; the value of Provincial Gas Companies' shares ruling remarkably high. This was partly due, no doubt, to the scarcity of safe investments, and the dearth of speculative employment for spare capital. From the point of view of the "promoter," there was absolutely no business going during the whole year; and the collapse of many large building societies, which marked this period as disastrous for thousands of small capitalists, drove a great deal of money back upon what are popularly regarded as reasonably safe investments for savings. It cannot be denied, however, that gas capital would be procurable at still cheaper rates, but for the prevalence of an undefined idea that there may be "something in" the competition of the electric light, which idea is created and fostered by the prominence given to electric lighting in the newspapers. As it is impossible for nine out of ten of the existing Electric Lighting Companies to earn a dividend, while the pressure of dear coal upon the Gas Companies has lightened, it is only reasonable to expect that the shares of the latter will be more run after in the near future than they have been in the present year.

One event in the history of gas lighting for the year calls for special notice—the cessation at Michaelmas of the supply of cannel gas to certain parts of London by The Gaslight and Coke Company, and its substitution by 16-candle coal gas, which thus became the general standard quality of gas for the Metropolis. Thus terminated a long-standing arrangement, the origin of which dates back to the time when no fixed principles were understood as governing the quality of the gas that should be supplied in a particular district. It was possible at one period that 20-candle gas might have impressed Parliament as being the proper quality for London. But that time is past; and whatever might now be the points of a successful agitation led by the Metropolitan Local Authorities against the Gas Companies—supposing such a movement to be possible—an increase of the nominal illuminating power of the gas would certainly not be among them.

Of legislation as affecting gas supply there is not much to inscribe among the *notabilia* of the year. The occurrence of the General Election effectually rendered the session a blank one in regard to social and industrial measures; and the Private Bill business ran very short. The Oxford Gas Company's Act contained some instructive new provisions; and the Swinton and Pendlebury Local Board Act was a specimen of the consequences that Municipalities may bring upon themselves by being too self-regarding in gas-works administration. As promising to result in legislation, this will be a suitable place for mentioning the Board of Trade Committee upon the standards of light for use in gas photometry, which has been sitting during the whole year, under the presidency of Dr. W. Odling. The Committee was appointed in order to advise the Department upon the means to be adopted for terminating the present unsatisfactory state of the law and practice of photometrical testing of the gas supplied in London. A searching investigation into all actual and proposed standards of light, suitable for use in the photometry of gas-flames, has been made under the direction of the Committee, mainly by the Secretary, Professor Vivian B. Lewes; and it is hoped that the outcome of the inquiry may be some definite suggestions upon which the Board of Trade can found an application to Parliament for an amendment of the Act relating to the subject.

As regards the legal business of the year, of a character specially interesting to gas engineers, the most considerable was the assessment appeals of The Gaslight and Coke Company, heard at Clerkenwell. A large sum of money was in dispute in this litigation; and the costs were simply enormous. The proceedings constitute a special chapter in the literature of gas-works valuation for assessment under the Poor Law; and, in the event, both sides claimed a victory. Another piece of business of a similar character was the appeal of the Birmingham Corporation against the assessment of outlying portions of their undertaking. An interesting question arose at Richmond, Surrey, as to payment for public gas-lamps not lit in consequence of frost. A point in connection with gas-works valuation for transfer, under certain circumstances, came up in regard to the price payable by the Kirkleatham Local Board for distributing plant laid down in their district by the Stockton and Middlesbrough Joint Water Board. The liability of owners of stills used in the manufacture of sulphate of ammonia to pay a licence to the Inland Revenue authorities was raised, but not finally settled. A remarkable dispute concerning the accuracy of registration of a consumer's gas-meter occurred at Ulverston. An action brought by Messrs. Gadd and Mason, nominally against the Corporation of Manchester, but really against Messrs. Ashmore, Benson, Pease, and Co., Limited, to establish the plaintiffs' claim to be sole patentees of methods of guiding gasholders by ropes, &c., without exterior guide-framing, failed in the Chancery Division, but was successful before the Court of Appeal. A remarkable action for slander, brought by a workman of the South Metropolitan Gas Company against the Assistant-Secretary of the Gas Workers' Union, had a good effect in teaching demagogues and Trade Union agitators to respect the law.

It would hardly be correct to inscribe water-gas processes among the new inventions of the past year; but water-gas manufacture as an aid to coal gas is still too much of a novelty to escape discussion in that capacity. The increasing price and growing scarcity of cannels suitable for carburetting ordinary coal gas, as made in London and the South of England chiefly from Durham coal, led to a good deal of experimenting with carburetted water gas as a substitute for cannel. It became more and more evident, also, that if carburetted water gas could be made at all in England, at a suitable price, it would be largely patronized, not only by the southern Gas Companies, but also—and even to a greater extent proportionately—by the northern undertakings which have accustomed their consumers to 20-candle gas and upwards. In addition to carburetted water gas, petroleum spirit was largely employed in different gas-works in place of cannel. Altogether, it is to be expected that the coming year will show a very notable progression along the lines opened up in this direction during the past twelve months. Next to water gas and carburetting by oils and spirit, the practical problem of inclined retorts has engaged the attention of British gas engineers, to the exclusion of other possible improvements in carbonizing methods. A good deal of money has been spent in various gas-works upon different modifications of M. Coze's suggestion; the history of the generator furnace being repeated in this connection—almost every engineer who takes up the idea of enlisting gravity with a view to the saving of labour in charging and drawing retorts having his own fancy respecting the best arrangement of the details of inclined settings. Good progress was made in the adaptation of machinery to the working of horizontal retorts; Mr. John West and Mr. W. Foulis having kept well to the front in this department of mechanical engineering. The use of oxygen in gas purification has also made some headway during the past year; a fresh impetus to experiment in this direction having been given by the introduction of Mr. Fanta's process as an alternative to the Brin-Valon method. The systems of guiding gasholders otherwise than by lofty external framework with which the names of

Messrs. Gadd and Mason and Mr. E. Lloyd Pease have hitherto been identified have made some progress; and the year has been signalized in the annals of gas-works construction by the completion, at the East Greenwich station of the South Metropolitan Company, of the largest gasholder in the world—a monumental work in six lifts, of which the upper two rise above the guide-framing. No notable advance in appliances for utilizing the light or heat of gas can be recorded among the events of the year. The construction of some large gas-engines was reported; gas cooking and heating stoves steadily improved their position; and various patterns of recuperative gas-lamps appeared to grow in favour with gas consumers. The Welsbach incandescent gas-burner improved its position as a rival of the incandescent electric lamp, more especially as a showy shop light.

With regard to the electric light, there is little to be said from the point of view of those who continue to suspect it of a tendency to supplant gas. Perhaps throughout the United Kingdom half-a-dozen examples of central station electric lighting undertakings have justified their promotion by earning a dividend; but it became so evident that the existing conditions of central station working, in which both plant and staff must be kept up to the capability of supplying a maximum demand which only occurs for a fractional part of every 24 hours, are inimical to profitable working, that proposals were freely ventilated for radically changing the basis of charging for the supply. An exhibition of electrical plant was held at the Crystal Palace in the spring, to mark the decennial of the rise of the electric lighting industry in this country; but the results of the venture were not satisfactory, either to the Crystal Palace Company or to the bulk of the exhibitors. The Vestry of the London parish of St. Pancras opened an electric light station, and substituted arc lamps for gas in some of the streets in their district. The City of London Electric Lighting Company began lighting certain main thoroughfares with arc lamps. The chief extension of electric lighting in London, however, was in the form of isolated plants, in many cases using gas for motive power. Notwithstanding this activity on the part of the electricians, the consumption of gas everywhere showed a satisfactory increase; and the experience of British gas undertakings in this regard was confirmed by similar reports from all parts of the world.

The various Institutions and Associations devoted to the advancement of gas technology had a year of activity, and consequently of prosperity. The Incorporated Gas Institute held a highly successful meeting in London, under the presidency of Mr. W. A. Valon, who earned great praise for the public spirit he displayed in discharging the duties of his office, the traditions of which he elevated and brightened by his example. The technical transactions of the Institute meeting were respectable, if not brilliant; but they were redeemed from the commonplace by the Murdoch Commemoration Lecture delivered by Professor Vivian B. Lewes. The centenary of the introduction of gas lighting by Murdoch was also fittingly celebrated by an interesting function held by the North British Association of Gas Managers, as a part of the proceedings of their ordinary annual meeting. It consisted in the presentation of a bust of the founder of the gas industry to the Custodiers of the Wallace Monument at Stirling, to be preserved among the memorials of Scottish worthies there collected. The bust was paid for out of a fund raised by the initiative of Mr. J. M'Gilchrist, of Dumbarton, for the purpose not so much of doing honour to Murdoch, as of delivering the living generation of gas engineers from the reproach of appearing to have forgotten their prototype. On the whole, it cannot be said that the commemoration of Murdoch in England or Scotland fell short of what was due to the occasion. The Institution of Gas Engineers met in London in May, and again (informally) in Birmingham in October, under the presidency of Mr. Charles Hunt, who approved himself a model head of such an organization. Both meetings were eminently interesting, and fruitful of instruction to those who attended; and it is particularly gratifying that this proof has been given of the possibility of bringing the members of a national society of gas engineers and managers together more frequently than once a year. The various District Associations of Gas Managers did well; but warning was not wanting of the desirability of upholding geographical considerations in arranging the meetings of these societies. A suggestion, which may perhaps bear fruit in the future, was made, to the effect that these district organizations of men professionally interested in gas supply might do something more for the industry besides producing papers and holding discussions. The American Gas Managers' Associations were disappointed of their wish to arrange for a gas lighting display at the Chicago Exhibition, which is to be opened next year. Otherwise, this class of societies everywhere have no reason to complain of their year's experiences.

In one respect the Incorporated Gas Institute calls for mention, in any chronicle of the year's doings, apart from other associations of the kind. We allude to the appearance of the President before the Royal Commission on Labour, for the purpose of reporting upon the conditions of work and wages in the British gas industry. Mr. Valon's statement, which is published as an appendix to the Transactions of the Institute, forms a valuable epitome of the truth of a matter respecting which some misapprehensions have prevailed. The Commission had the advantage of hearing from one of its own "trusty and well-beloved" members, Mr. George Livesey, tolerably full particulars respecting the strike of stokers at the various South Metropolitan Gas-Works in 1889; and other evidence relating to the gas industry was given before the Commission during the year, the whole of which was specially reported at the time in the columns of the JOURNAL. Whether it was due to the fact that the truth in regard to employment had been told before the Commission, or to the circumstances that the tyranny of the New Trades Unions had been broken by repeated failures to dominate the labour market, or to any other cause, we cannot say; but it is certain that the past year witnessed the full resumption of the normal conditions of employment in the great majority of British gas-works.

The continued success of the City and Guilds of London Institute's Technological Examinations in Gas Manufacture is a pleasing evidence of the extent to which the followers of the industry appreciate the advantages of such a grounding in its first principles as is required of those who would obtain the prizes and pass certificates of the Institute. This subject is now mentioned for the first time in our Annual Retrospect, because we hold that fairness to the Managers of the City and Guilds of London Institute demands some recognition by us of the completeness with which they have equipped the gas industry of these kingdoms with such a standard of technical education as associated gas managers themselves have failed to erect, although repeatedly invited to attempt the task by those who had at heart the best interests of the industry. No association of gas managers, national or provincial, now contemplates doing anything for the education of the young recruits in the ranks of gas engineering. For this there are doubtless various reasons; but the best of them all is the consciousness that no such effort is now needed outside the City and Guilds Institute. The Society of Arts conferred a boon upon the gas industry by arranging with Professor Lewes for a set of Cantor Lectures upon the generation of light from coal gas.

Of accidents and casualties in and about gas-works, there have unhappily been several regrettable instances during the year, especially in what may be designated as employments incidental to gas making, such as excavating and bricklayers' work, which have only the same connection with gas manufacture and distribution as they have with other heavy industries. Gas-works accidents, strictly so called, because they could hardly occur anywhere else, happened at Nottingham and Bradford—both being tar-well explosions. The latter, unfortunately, was attended with loss of life and injury to the person, as well as with serious destruction of property. There were the usual number of explosions of gas in houses, traceable to the apparently ineradicable propensity of people for seeking for leaks with a light. Gas accidents of this kind, however, were far outnumbered by oil-lamp explosions and conflagrations. The reputation of electricity for innocuousness was not well maintained. Besides causing fires by the overheating of wires, and death from contact with naked wires conveying a high potential current, electricity has been detected in insidiously destroying the integrity of gas and water pipes in the vicinity of what were supposed to be insulated cables.

Last year's tale of deaths in the ranks of gas engineering and administration is mournfully long—this circumstance

being probably traceable to the influenza epidemic which visited these islands during the early spring. Mr. Robert Harris, late of The Gaslight and Coke Company, and an ex-President of The Gas Institute, Mr. W. T. Walker, of the well-known Donnington firm, Mr. W. H. Bennett, late Secretary of The Gas Institute, Mr. Charles Heisch, late Chief Gas Examiner for the Corporation of London, Mr. F. C. Hills, the founder of the industry of gas-works residuals conversion, Mr. John Chapman, Mr. Hodgson Jones, Mr. C. E. Walduck, Mr. H. M'Lauchlan Backler, Mr. W. H. Michael, Q.C., Mr. E. Ryde, the surveyor, and Mr. John Somerville, were all well-known men in their day, and some of them will be long remembered for their own special services to the world-wide gas industry. May they rest in peace, and may all that is good in their examples inspire us who yet remain in the land of the living to do our duty faithfully until our own time shall come!

There were not many official changes of importance during the year in British gas-works, although there were a good many minor appointments made. Mr. F. G. Dexter was promoted to the position of Manager of the Winchester water and gas undertaking; Mr. W. R. Herring went to Huddersfield; Mr. C. Meiklejohn succeeded, at Rugby, the veteran Mr. Peter Simpson, who received on his retirement most gratifying testimony of the affection and esteem in which he is held by his professional brethren. Mr. C. B. Newton went to Rotherham; Mr. J. G. Newbigging was appointed to Macclesfield; and Mr. T. Price, to Walton-on-Thames. Mr. T. N. Ritson left Jersey for Kendal; and Mr. W. Carr returned from Johannesburg. There was, on the whole, a fair amount of movement in the managerial and sub-managerial circles, which went to show that gas engineering does offer a respectable career for those who have aptitude for, and training in it, although complaints are sometimes heard of overcrowding in the profession, as in most others. It is certain, however, that as time goes on there is less and less favouritism shown in the bestowal of the better class of appointments in gas-works, albeit this evil will never probably be wholly eradicated. We would fain hope, moreover, that an improvement is being shown in the conditions under which appointments are thrown open, the salaries attached to them being more frequently stated in the advertisements inviting applications, and the vicious custom of putting up highly responsible offices to the lowest bidder being to the same extent discontinued. We take credit to ourselves for promoting and encouraging this reform; and we shall persevere in denouncing all tricks tending to degrade the honourable calling of the gas manager, whenever and wherever we discover them.

The past year was marked by a revival of the movement that has been somewhat in abeyance for a short period, which has for one of its consequences the conversion of gas managers into officials of Local Authorities. Since the electrical scare of ten or twelve years ago, there has not been so much talk of the acquisition of gas-works by Local Authorities as cropped up all over the country last year. The Sutton Coldfield Gas Company ceased to exist—their property having been taken over by the Birmingham Corporation; and transfers were either arranged, or discussed with a view to ultimate business, at Bideford, Accrington, Pontypridd, Todmorden, Barry and Cadoxton, Willenhall, Sevenoaks, Belper, and other places. This record cannot be regarded otherwise than as satisfactory, because, although one may entertain a distinct preference for seeing gas supply carried on as a commercial undertaking rather than as a means of raising money in aid of local rates, it is eminently desirable that the last shred of suspicion in regard to the stability of the gas industry—to the existence of which the check in the transferring process was due—should be dissipated.

In concluding this review of the year's doings in regard to the industry of gas supply in the United Kingdom, we may be permitted to make a few comments upon the two volumes of the JOURNAL which cover the period under notice. As the industry has grown and developed, so its contemporary literature has swollen in bulk, and (we would fain believe) has improved in quality. It has become necessary to take a wider view of things and topics in general, as connected with gas manufacture and supply, than was considered desirable, or even possible, a few years ago. The reproach of narrowness, ignorance of any other but the rudest, and carelessness of all but the most sordid aspects of their work in the world, was at one time freely applied to all gas-works officials. Whether or not this reproach was ever justified, it is unnecessary now to consider; for the day is past when shovelling coal and coke was popularly imagined to constitute the whole work of gas-making. No true gas engineer despises the shovel; but the best gas is made now-a-days with brains as well as coal, and the consumption of one kind of raw material has to be made good as regularly as that of the other. Year by year we are compelled to let pass more of the local news, which, however interesting it may be to one or two subscribers, possesses no lesson for others. This must be our apology for ceasing to publish reports of Gas Companies' meetings which contain no element of novelty or point of importance, and for compressing to the shortest limits, consistent with fair presentment of the facts, those which it is necessary to put upon record. For the rest, we give yearly more original articles, more criticism of matters and statements generally interesting to our readers, more discussions, more special parliamentary, law, and statistical reports, than ever. In a word, we address our labours to the reader—be he director, town councillor, engineer, manager, secretary, manufacturer, or what not, who takes an intelligent interest in following the contemporary development of the gas industry as a whole, who feels himself one of a large order of men similarly circumstanced, and who does not confine his thoughts to the particular corner of the universe where his lot may for the time being be cast. The JOURNAL is the oldest of the special, or as they are called "trade" organs appearing in the United Kingdom; and it is our constant study to make it one of the freshest in style and appearance, and strongest in substance. With this issue ends our sixtieth volume; and we intend and hope that the sixty-first volume will be as vigorously modern in every respect as though it had no predecessors stretching back to an origin which in journalism is quite archaic.

WATER AND SANITARY AFFAIRS.

AMONG the incidents which attracted notice in connection with the Metropolitan Water Supply at the commencement of the year now drawing to a close, a conspicuous place may be assigned to "the agreed Bill" by which the London County Council were to obtain extraordinary powers against the Water Companies; the Corporation being induced to join the project in consideration of being represented to the extent of one-eighth on a "Joint Committee." So completely were the Corporation cajoled or coerced into this scheme, that they consented to have the draft of the Bill altered, so as to eliminate a clause which they had proposed, fixing a period within which the Companies' undertakings should be purchased. By the middle of January, the situation was changed by the action of Lord Salisbury's Government; an announcement being made that a Royal Commission would be appointed to inquire into the adequacy of the existing water supply of London, having regard to the future growth of the population. Although it was obviously necessary that this inquiry should be finished before any legislation on the main question was attempted, the County Council resolved upon proceeding with their Bill. This decision was the more unseemly, as the Council had been pressing the Government to undertake the investigation of the subject. The conduct of the Council was also at variance with the views of Sir John Lubbock, who held the post of Chairman at that time, and who declared that, although there was a consensus of opinion in the Council that the water supply should be placed under municipal management, he was himself "unconvinced" as to the wisdom of such a course. Some peculiar tactics were exercised by the London County Council and the Birmingham Corporation, in reference to the Water Bill by which the latter authority proposed to draw a supply for their city from the Rivers Elan and Claerwen in Mid-Wales. Opposition was threatened from the Council, on the ground that Birmingham was thus seeking to forestall London in obtaining a particular source of supply. At length a kind of truce was established, and the Bill passed its second reading in the House of Commons after a debate which lasted three hours; the Council being granted *locus standi* before the Hybrid Committee to which, in the usual way, the Bill was referred. It was a

month later before the London Water Bill reached its second reading, shorn of some of its pretensions; the scheme having been modified at the suggestion of the President of the Local Government Board, to save it from entire extinction. Early in March, the elections for the second County Council effected a change in the constitution of that body, which excited a degree of alarm among holders of shares in the Water Companies. But the progress of events served to show that such apprehensions were at least premature; and confidence was soon restored. The disposition of the Council is one thing; the power to execute certain designs is another. Towards the end of May, the London Water Bill emerged from the hands of a Select Committee of the House of Commons, presided over by Sir J. Pease, but in so altered a form as to render it only a shadow of its former self. The Statutory Committee was gone; and the Corporation were thereby excluded. On the other hand, the County Council were to be authorized to expend a further sum not exceeding £10,000 on inquiries into the water supply; and power was also given to promote Bills in Parliament on this subject. Some means of doing mischief were accordingly retained; and the County Council professed to be immensely gratified. In this form the Bill ultimately passed both Houses, and received the Royal Assent. The Birmingham Water Bill succeeded in getting through Parliament with no material alteration, although considerable opposition was offered. In the House of Lords, the time for the completion of the works was fixed at ten years; and the supply of water to authorities within a radius of fifteen miles was made compulsory, instead of optional.

The prominence given to the London Water Question last year naturally led to a certain amount of controversy; and interest once more centred round Lord Cross's Purchase Bill of 1880. Sir William Harcourt was especially indignant at a statement made by Mr. A. J. Balfour, that the Conservative party would have given the London Water Supply into the hands of a public authority, by means of Lord Cross's Bill, only they were "foiled by the "machinations" of Sir William. The latter replied with an attempt to throw the entire responsibility on the Select Committee of which he himself was Chairman. At the same time a keen debate arose as to the financial result which would have befallen the ratepayers had the terms negotiated by Mr. E. J. Smith been ratified by Parliament. Sir William spoke of "reckless and ruinous agreements." Sir Thomas Farrer, who also took part in the discussion, refused to consider what the municipality "might have "made" by the bargain, and threw doubt on some figures which Mr. Burdett had produced on the subject in his "Official Intelligence." Mr. Burdett speedily rejoined; requesting Sir Thomas either to withdraw his aspersion, or substantiate the accusation. On this point the evidence of Mr. Samuel Wood before the Corporation Committee under Sir Guyer Hunter was also available, and helped to show that, in the absence of legislation hostile to the Companies, the terms negotiated by Mr. Smith were favourable to the ratepayers. Sir T. Farrer subsequently withdrew his imputations on the accuracy of Mr. Burdett's statistics. In the latter part of the summer, the presence of cholera on the Continent excited some anxiety on this side the Channel, and led to increased vigilance on the part of the leading sanitary authorities. The Local Government Board addressed a communication to the London Water Companies taking their supply from the Thames and the Lea, urging them to adopt special care in order to secure efficient filtration. The Board had only occasion to consult Dr. Frankland's reports in order to see that the London Water Companies were rather to be commended than admonished with regard to their filtering processes. A singular addition to the literature of the Metropolitan Water Question appeared a few weeks back. In outward show, it was a book; ostensibly, it was a report to the London County Council by Mr. H. L. Cripps; practically, it was a County Council report, printed and published at the cost of the ratepayers. Mr. Cripps is the Parliamentary Agent of the Council; and his treatise was with reference to "The Position of "the London Water Companies, considered from a Parliamentary and Legal Point of View." Of course, the Companies were shown to be in a very defenceless position, and to be practically at the mercy of Parliament and the County Council. But other considerations will have to be weighed when the question comes up for settlement. Looking back on the evidence given before the Royal Commission, we find it bearing very largely in favour of the London Water Companies; and it must, we think, lead to a very satisfactory conclusion respecting the character of the present supply, and the possibility of extending it. The correction made in the statistics in regard to the extent of the population, and the volume of water pumped, helps to show the sufficiency of the present supply. Geological and engineering evidence may be said to have established the fact that the watersheds of the Thames and the Lea are capable of supplying all that London will require for a long series of years to come. On the question of purity, there has been evidence of a most satisfactory nature from Dr. Frankland, Dr. Percy Frankland, Dr. Odling, and Mr. Crookes. The lamented death of Dr. Tidy has alone prevented us from adding his name to this list. The attitude of the County Council before the Royal Commission must have been rather perplexing to that body. Mr. W. H. Dickinson, the Deputy-Chairman, when appearing as a witness, stated that the Council had decided not to take up any definite position, either favourable or antagonistic to the present methods of supply. All they undertook to do was to furnish information.

The watershed question has been the subject of renewed discussion, partly in connection with the Birmingham Bill. The Severn Fishery Board addressed a communication to the Chief Inspector of Fisheries, suggesting that the Board of Trade, or Parliament by means of a Standing Order, should lay down certain general rules applicable to all cases where authorities "come out of their own dis-"trict to take water from another district." Liverpool has long ago settled this question for itself; and the Vyrnwy water supply for that city was inaugurated last July by the Duke of Connaught with much *éclat*—His Royal Highness bearing emphatic testimony to the skill and energy with which Mr. G. F. Deacon, the Corporation Engineer, had carried out the colossal undertaking. Next session, the Liverpool Corporation will seek power to raise capital for the execution of works whereby a supply of water in bulk will be furnished outside the compulsory limits. The London County Council are also preparing to go to Parliament, seeking for further powers relative to inquiries and negotiations, including the water supply. The East London Water Company have a Bill for raising half a million of money, for meeting the cost of works designed to cope with the increase of the population in their statutory area.

Forthcoming Private Bill Legislation.—The time for depositing in the Private Bill Office of the House of Commons all Private Bills which will be promoted in the ensuing session of Parliament expired last Wednesday night, when only 183 Bills had been lodged. This number is the lowest on record during the last 20 years; the nearest approach to it being in 1887, when only 193 Bills were deposited. Compared with last year, when 219 Bills were lodged, the decrease is 36. Of the total number now deposited, 144 relate to England and Wales, 25 to Scotland, and 14 to Ireland.

Professor Lewes on the Inventor of the Regenerative Burner.—Just as we were going to press, a letter on the above subject reached us from "Owen Merriman." He says: A curious chapter in ethics is opened up by Professor Lewes's reference (in his last Cantor Lecture) to the original inventor of the regenerative gas-burner. The lecturer takes this distinction from the (late) Rev. W. R. Bowditch, upon whom it had rested hitherto undisputed, and gives it to Dr. Frankland, who is said to have devised a burner identical with Bowditch's, but a year earlier. Frankland wrote the article on "Coal Gas" for the fifth edition of Ure's "Dictionary of Arts," &c., which appeared in 1860. In the course of this article, he described and figured the Argand burner with double chimney, and distinctly asserted that it was his own contrivance. Bowditch published, in 1867, his "Analysis, &c., of Coal Gas," in which appears the identical illustration that had figured in Ure's "Dictionary." Bowditch, however, claims the burner as *his* invention; and he goes on to state that Frankland had "experimented with my apparatus, and given a figure of it in the article"—that is, the article on "Coal Gas" above referred to; thus directly implying that the burner Frankland wrote about was not his own invention. More strangely still, after being thus implicitly taxed with appropriating what was not his own, Frankland republished, in 1877 (in his "Experimental Researches"), the article from Ure's "Dictionary;" still declaring the invention to be his, but taking no notice whatever of Bowditch's implication to the contrary, which an aggrieved man might have been expected to do. The date affixed to the reprint is March, 1854, which, as stated above, is not the date of its original appearance, but six years earlier. Clearly, one of the two is in the wrong. Which is it?

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1139.)

THE current week presents but a small field for the observation of market movements in the Stock Exchange. The closing of the House on Saturday curtails the sphere of action by one day; while the proportions of the period to be reviewed are still further abbreviated by another day, owing to the inexorable demands of the festive season imposing upon us the necessity of going to press two days in advance of the ordinary time. After all, however, there is but little to chronicle which presents any feature of interest. With the holidays imminent, the week opened very tamely and quietly. Prices kept pretty well up to the mark, but hardly any fresh business was undertaken. As the week advanced, business fell away more and more; and, as a natural consequence, where support was lacking, the tendency was to drop. However, no change of any consequence took place, which was pretty good. Indeed, things might well have been worse, having regard to the position of Government affairs in Paris, the condition of silver, and other disquieting topics. The Money Market is quite unchanged in the main. Slight and ephemeral demands arise; but rates generally are unaffected substantively. But while most markets have been far below the par of activity, the Gas Market has been well up to the average of recent weeks. The growing tendency to firmness which has been foreshadowed during that period has been fully confirmed in the current week. Gaslight "A," which has been so consistently firm at unchanged figures week after week, has been unable any longer to resist an advance, and it has moved up 1½; the best mark at which business was transacted being 222. The continued demand for investment stocks has also been in evidence by the excellent prices at which the debenture and preference issues have been purchased; the 10 per cent. preferences advancing in quotation. South Metropolitans are in good request; and, though the figures have not varied, stocks can only be had at nearly top prices. Commercials are inactive. Among the Suburban and Provincial Companies, the only change to be noted is a small advance in Alliance and Dublin. The Continental undertakings are firm and unmoved; and, among all the rest, the only change to be found is an advance in Melbourne debentures. Water are, for the most, steady and unchanged after their recent advance; but Southwarks have gone up a little more. Debenture and preference issues are wanted.

The daily operations were: Good steady business characterized the opening day, with nice prices all round. Melbourne debentures rose 1. Tuesday was a brisk day, especially for Gaslight "A," which advanced 1½; while almost everything realized good figures. Wednesday began to show signs of greater quietude; bnt values were unabated. Alliance and Dublin new rose ½. Southwark ordinary improved ½; and ditto "D," 1½. Thursday was quiet, but very firm. Gaslight "C," "D," and "E" improved 1.

A STUDY IN INDUSTRIAL COMPETITION.

PROBABLY at no previous era of the world's history has there been so much seething effort as may now be felt, rather than seen, around us through the medium of announcements in scientific and technical publications, in the ever-widening field of applied science, directed to the achievement of fresh victories of mind over matter, to the creation and supply of new wants, and to the discovery of quicker, cheaper, or easier methods of satisfying recognized needs. We say that this effort and bustle may be felt rather than seen, because it is a remarkable feature of so much of the technical and scientific literature of the day that it is suggestive rather than descriptive. The casual skimmer of the multitude of papers, memoirs, and communications which fill the pages of British and Foreign technical periodicals would often be led to exclaim against the apparent pettiness, obscurity, and lack of point in much that he would find gravely detailed in these not very amusing publications; but, though he might be right in concluding that chemical and physical literature may sometimes be quite as trashy as the drivel of the "Society" journalist, the chances are that he and a competent judge in such matters would differ widely as to the precise matter to which this condemnation should be applied. The casual reader, for instance, would approve of the striking descriptions of the wonders of Nature, and of pretty experiments, with which so many self-styled popular journals of science are filled; while the earnest student would consign all such items to his waste-paper basket. On the other hand, the student would perceive a memorable revelation in the bare announcement that some Russian with an unpronounceable name had succeeded in isolating a new chemical compound having a still more awful title, of no manner of use that any mortal could suggest. But the value of such an announcement as the latter does not consist so much in what is stated as in what is suggested or implied. It means that somebody, perhaps working for quite another object, has found a little, insignificant door open in the ramparts behind which the treasures of the Earth-Spirit lie hidden. The discoverer is content to note the fact; and he passes on. The discovery may be a big or a little one, as mortals judge such things; but, at all events, it is marked down, for the benefit of all whom it may concern, now or hereafter. Moreover, the mere circumstance that anybody, presumably with a living to get, should have been found poking into such holes and corners of science as are revealed by these sparks of intelligence is striking evidence of the intensity and range of the exploring work that is actually going on in the world. This is what we mean by saying that the efforts of seekers after new things in the domains of science and technics can be felt rather than seen. When we learn that a certain sample of soot yielded upon analysis a fractional proportion of manganese or copper, the importance of the report is perhaps small, regarded for what it expresses; but it is by no means a small thing to hear that such researches are going on. Here it is not so much a question of what the man has picked up, but what he was going for.

One consideration is apt to strike an observer of this incessant unfathomable ardour in discovery, which is the wonder how the old methods stand it. Every art and industry under the sun appears to be undermined by these researches after new ways and short cuts; and it almost appears at times as though there can be no sound foundation for any manufacture or business on the earth. This idea is supported by the circumstance that now and again an industry really is superseded; the burrowings of the searchers into the nature of things having led them to something which eventually explodes like a mine under the old-established business, sending it into the *Ewigkeit*. Such was the discovery of the artificial preparation of alizarine, which in the course of only a few months took away for good the occupation of the madder cultivators of the Balkan Peninsula. It would be difficult to set bounds to the possibilities of this kind of surprise; since it would be practically impossible to name the trade or manufacture that does not rest on a basis more or less open to the sappers and miners of science and invention.

Regarded in this way, as a timid observer might do, it would seem that the course of modern industrial discovery and application is largely a progress of the substitution of one thing for another. It is rarely that the old industry assimilates the new improvement or substitute. Such is not the way either of Nature or of Man. Instead of trying to adapt the old to receive the virtues of the new, the former is thrown aside, and the latter takes its place. How many illustrations of this natural process occur to one's mind in connection with the advance of modern material civilization! Yet it would be an error to think of all, or even of the greater part, of industrial progress as an exercise in substitution. It is a most remarkable fact that, in many cases where men have believed that the introduction of something must be over the corpse of its predecessor, the latter has hardly shifted its ground, or has merely turned aside sufficiently to give the new-comer room; and thereafter the two interests have flourished side by side. It is extremely difficult to predict how the success of a new industry will affect that which has gone before it. Supersession may be the result; but, in order to bring this about, the fruits of the new must be so identical in character with those of the old, only endowed with some indubitable preference on the score of quality, or cheapness, or other controlling feature, as to leave no market for both. This can very rarely be; for Nature never replicates her works, and there is almost always sufficient difference between them to give each a chance of surviving.

We had occasion recently to comment upon the appearance of Mr. Ludwig Mond's alkali process, which is heralded as promising to knock away the last prop from under the now discredited Leblanc process. This promise may be borne out; but, from the general considerations we have here advanced, it might be held quite possible that the future of the alkali trade may not run only along the single line thus laid down for it. In connection with the discussion of this subject of the supersession of one industry, or one process, by another, it is instructive to glance at the history of the manufactured iron industry since the introduction of cheap steel. Nothing can more clearly illustrate the hazards of prophesying in regard to the course of a trade, than the actual condition of that which is concerned with manufactured iron. As a contemporary has remarked, in signalizing this state of things, it is now a good many years since everybody connected with the iron trade thought it would be subjected to a revolutionary change; the production of malleable iron being displaced by the newer, and in some respects more suitable, metal known as ingot iron, or steel. As a matter of fact, open-hearth steel has now almost wholly displaced iron in shipbuilding and for other structural purposes, as well as in the great majority of ironmongery goods; while for railway purposes Bessemer steel has all its own way. It might naturally be supposed that the result of this incursion of steel would be to destroy the malleable iron trade, and that consequently the districts which formerly lived by the production of puddled iron would now be desolate. This is by no means the case. Though the trade in steel goods is firmly established, apparently to the detriment of iron, wrought iron still holds its own, and the output in some localities is being considerably increased. Nor is this phenomenon to be wholly explained by reference to the conservatism of blacksmiths and other customers of the iron manufacturer in old countries; seeing that in the United States the production of wrought iron is actually gaining upon

that of Bessemer steel. It is more reasonable to suppose that, although so nearly resembling one another in quality and uses, ingot metal and wrought iron has each its own particular market, and that these markets will remain open side by side for an indefinite period.

This reflection may be comforting to the timid souls interested in more than one industry that might be named here, who, the moment they hear of a proposal to do in some different way the work by which they live, are forthwith daunted with the dread of seeing their occupation taken from them, and shared by strangers. The illustration of the manufactured iron trade is valuable here, as showing how it occurs that a displacement of one branch of industrial employment by another, albeit regarded by experienced judges as imminent, has not taken place. Perhaps, if the makers of puddled iron had been "protected" in any way, so as to be deprived of the energy that comes from a sense of having nothing but one's own hands and brain to trust to, or if they had accepted other people's predictions of their impending ruin as conclusive, the threatened disaster might have become a real catastrophe. As it was, they simply took no notice of what was prophesied concerning their fate, and went on making iron as usual; and now they are in possession of as good a business as ever. *Verb. sap.* Prophesying is good fun for those who have nothing better to do; but whosoever undertakes to predict the course of trade from the appearance of novel conditions, essays a more than usually futile exercise of the imaginative faculty. Discoverers will work at the problems they set for themselves, and discoveries will be made in all corners of the industrial world; but for one new art that displaces an old one, a hundred will create demands as novel as themselves.

AMERICAN VIEWS ON GAS MANAGERS' ASSOCIATIONS.

One of the most attractive papers read at the recent meeting of the American Gaslight Association—so far as may be judged by the extent of the discussion to which it gave rise, and also by the fact that it was honoured by a remit to the special consideration of the Council, with instructions to report thereon at the next meeting of the Association—was that submitted by Mr. W. R. Addicks, of Boston, and entitled, "A Gas Association and Its Members" (*ante*, p. 1041). This was not so much due to the intrinsic merit or distinctive novelty of the views expressed therein, as to the fact that the author seemed to strike upon one or two matters that had evidently occupied the consideration of some of the most prominent members of the Association for a long time. Instead of dealing with the suggestions actually offered in the paper, and the various *pros* and *cons.* relating to them, discussion seemed to drift into expressions of opinion on the defects of Gas Managers' Associations as they are at present carried on. And it appeared to centre round two ideas. The first was aptly and pithily explained by Mr. A. C. Humphreys, who compared Gas Managers' Associations with steam-engines in which the efficiency is low and the waste consequently great. Another speaker put the same idea in a different form by saying that there was a great deal of useless repetition at these meetings. A paper is read on a certain subject; a discussion follows; and then the matter is dropped, and left in a more or less incomplete and indefinite condition. After a time the same subject is trotted out again by another writer; and in this second paper, together with its discussion, a great deal of the ground traversed in the first instance is gone over a second time. "Leakage" was specifically mentioned as an illustration of matters that had gone the round of the Associations—to nearly the same tune in each case. The second idea was an offshoot of the first. It naturally follows that, with so much repetition, the degree of real progress is small. The paper is read, the discussion taken; and yet the subject remains very much where it was before, although the avowed object of this proceeding is to set it a decisive step in advance. In order to secure this desirable end, it was thought that the loose and tangled threads left at the conclusion of the discussion might be gathered up by a Committee appointed for the purpose. Answers to questions, given in an indefinite or cursory manner, for example, should be supplemented by specially obtained information, or knotty points might be settled by experiment, so as to put the whole thing in such a shape that it could be taken up at any future time just at the place it was left, without going back to the original starting-point.

It will scarcely be questioned that these two expressions of opinion are correct, not only as regards American Gas Managers' Associations, but also those on this side of the water. A rapid glance over the reports of the transactions of any of our English Associations will furnish plenty of examples of the useless repetition, and of the labour without progress, that was complained of at Boston. If we combine the transactions, and regard them as one volume prepared for the benefit of the gas industry generally, these defects become the more marked. It will be found that, even within the space of one year, a subject which happens to claim popular attention has been discussed, let us say, in the North, and also, in almost identical terms, at another meeting in the South. The same facts are presented with a little variation in the way of arranging them. In a similar manner, points that have been repeatedly raised, yet still remain unanswered, might be quoted. Or sometimes much time is occupied by mere quotations or compilations from works that are readily available. Having admitted this much, however, it must be pointed out that these two objections might be raised with regard to all scientific papers or discussions. Repetition and indefiniteness are, unfortunately, by no means confined to Gas Managers' Associations. The name of any other branch of theoretical or applied science or art might with equal justice be substituted for "Gas Managers." Yet this does not detract from the credit due to the gentlemen who have called attention to these defects, or render their reduction to the lowest possible point a matter to be the less desired, or a goal to be approached as closely as may be possible, by all earnest workers in the progress of our industry. Nor is it likely that they can be entirely remedied. During the ensuing year, about a dozen Presidential Addresses will be delivered to audiences of gas managers in the United Kingdom alone. What would the authors of these discourses say, if they were rigidly debarred both from repetition and from indefiniteness? But if, as a result of reading these remarks, they are led to refer more carefully than is sometimes the case to what has already been done, said, or written on the particular points to which they may wish to direct attention, our endeavours will not be entirely barren of results. But the matter is not one that can, as our American friends seem to think, be remedied by Act of Parliament. Improved constitution and more co-operation between different districts may do something; but so long as meetings of gas engineers are held at stated intervals, with a fixed period of time devoted to reading of papers and to discussions, so long will it be necessary to fall back, to a greater or less extent, upon the eloquence and ability of Past-Presidents or other other prominent members, to come forward at short notice to fill up the *hiatus* caused by lack of papers, or to get up a semblance of a discussion. These things can only be done by dressing up old and well-worn topics with new verbiage.

Returning to the paper that gave rise to these suggestions, it consisted broadly of a scheme for the amalgamation of all the American Gas Managers' Associations into one centre, having the American Gaslight Association for a head. This is very similar to the lines upon which the Society of Chemical Industry is worked in the United Kingdom. In that Society we have the head-quarters in London, and the District Sections at Manchester, Glasgow, Nottingham, &c., each with its own place of meeting and board of officials, but working in connection with, and under the control of, the central authority. Here we have, also, exactly such an official record of proceedings as that which was indicated by Mr. Addicks. This gentleman dwelt at some length on the question of standards, and of practical and scientific investigation; and his projected united society would have special committees for each of these subjects. But some of his suggestions appear rather crude and ill-digested. He would have, for example, "all members graded according to their position and experience." What board or committee would care to undertake the classification of any and every member according to these conditions? It would be impossible to discharge such an invidious task to the satisfaction of all concerned. Members might be graded according to their age, the date of joining their Association, or the initial letters of their names; but who is to say that A is more experienced, or holds a higher position, than B or C? Perhaps the fact of remitting the paper to the consideration of the Council told against its consideration by the meeting, or attention was diverted from it by the points above named. Be that as it may, it is to be regretted that some of the "shining lights" of the meeting did not express their views upon the question of amalgamation, or some of the other points raised in it.

Italian Lignite.—The British Consul at Rome refers in his last report to the attempts which have been made of late years to use Italian lignite, by means of a process of distillation, as a substitute for coal on a large scale, and also to extract from it illuminating gas. The Government have in various ways encouraged and assisted the production of lignite, even to reducing to the minimum the railway freight for this material; but, from a report recently published by the Ministry of Agriculture, it appears that up to the present no great success has attended these endeavours. It has been calculated that the quantity of xiloide lignite embedded in the more important mines throughout the whole kingdom may amount to 75,000,000 tons, yielding at present an annual produce of 331,000 tons, which could be raised to 768,000 tons. To these are to be added the layers of tar lignite, which may contain 8,570,000 tons, and which at present yield 33,160 tons a year, This latter production could be raised to 185,000 tons. The two qualities of lignite, taken together, would then give a total production of less than 1,000,000 tons; while every year Italy consumes imported coal to the extent of 4,500,000 tons. Taking into account the heating power of Italian lignite, which is half that of English coal, this maximum production would represent less than one-eighth of the actual importation of coal; but, if it is remembered that the present importation of coal co-exists with the production of lignite, the additional maximum production of the latter would only affect the present coal imports to the extent of one-fifteenth.

COMMUNICATED ARTICLES.

THE EDISON LAMP DECISION.

By Our American Correspondent.

The most interesting matter, by far, occurring of late in the electric side of the lighting business in America, is the Edison lamp decision recently handed down by the United States Circuit Court. The decree was on an appeal from a decision of the Circuit Court of the southern district of New York in the case of the Edison Electric Light Company against the United States Electric Lighting Company, for an infringement of the patents of the former Company in relation to incandescent lamps. The suit was originally brought under three patents —No. 223,898, dated Jan. 27, 1880; No. 227,229, dated May 4, 1880; and No. 265,777, dated Oct. 10, 1882. By stipulation, however, the bill was amended by withdrawing the last two patents. The case was originally tried before Judge Wallace, with a decision in favour of the Edison Company, from which an appeal was taken—this decision being on the appeal.

The decision, by Judge Lacombe, recites that on Jan. 27, 1880, under an application filed on Nov. 4, 1879, a patent (No. 223,898) was issued to Thomas A. Edison; and, by subsequent assignment, this passed to the complainant. The four claims of the patent are: "(1) An electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance, made as described, and secured to metallic wires. (2) The combination of carbon filaments with a receiver made entirely of glass, and conductors passing through the glass, and from which receiver the air is exhausted, for the purposes set forth. (3) A carbon filament or strip coiled and connected to electric conductors, so that only a portion of the surface of such carbon conductors shall be exposed for radiating light. (4) The method described of securing the platina contact-wires to the carbon filament, and carbonizing of the whole in a closed chamber."

The decision goes on to say that the lamp, as made by the defendant, does not infringe the third or fourth claims. This was admitted by the complainant. The Lower Court held "that the first claim was, by its phraseology, limited to lamps in which (among other things) the leading-in wires are secured to the filament according to the method of the patent—that is, by cement carbonized *in situ*; and that as the defendant uses clamps for the purpose, it does not infringe. This construction of the first claim having been acquiesced in by the complainant, who has not appealed from the decision, there remains for consideration only the second claim." The decision then goes on to give a description of the defendant's lamp, and to state that electric lamps are divided into two classes—arc and incandescent. A description of these two modes of lighting follows, which closes with the sentence: "The longer the life of the burner, the longer the life of the lamp, and the more available it becomes for practical electric lighting." After speaking somewhat further as to the philosophy of the electric light and the importance of the non-conducting or illuminating portion of the lamp, and the proper ratio of its resistance to the resistance of the entire circuit, "and to its own radiating surface being so graduated that a light of the required intensity is produced by the expenditure of so small an amount of current at each illuminant focus as to admit of main conductors sufficiently small, and therefore sufficiently low-priced, to warrant the introduction of the system into public use," the decision continues as follows:—

> It is not necessary to enter into any elaborate discussion of the prior state of the art, so far as it bears upon the question of the patentable novelty of such embodiment of the principle of high resistance and small radiating surface. Irrespective of all patents or publications of others, the philosophy of this method of producing light is undoubtedly found stated clearly and sufficiently, and applied to the production of an incandescent platinum burner, in Edison's French patent, No. 130,910, taken out May 28, 1879. Whether, under section 4887 of the "Revised Statutes," that patent, embodying as it does his own invention, is or is not, so far as Edison is concerned, a part of the prior art, and to what extent, in view of the prior art, that patent discloses patentable invention, need not be determined upon this appeal, inasmuch as we are satisfied that there was invention in the substitution of the carbon of the patent in this suit for the platinum of the French patent, even though all knowledge as to what should be the ratio of resistance to radiating surface were pointed out, either in the French patent or elsewhere in the art. In his invention, as described in the French patent, Edison departed from the existing idea of burners of low resistance; declared the commercial and scientific necessity of burners of high resistance, although they must be slender and presumably fragile; and attempted to find a method of protecting them from the effects of heat and of the atmosphere. It is said that the theretofore known laws of electricity should have taught everyone that an electrical incandescent lamp must have a burner of small cross section and small radiating surface. The electrical laws had been known and had been recognized; but they did not tell how to protect the materials which would be efficient burners from the destructive effect of other forces than electricity to which they must be subjected—in other words, they did not tell how to construct a lamp. Edison in his French specification followed the principle of high resistance to an extreme, made platinum burners with a resistance of 200 to 300 ohms, and described the method by which they were to be prevented from speedy deterioration, "by destroying or intercepting the atmospheric action." He freed them from occluded gases by subjecting them to a high degree of electrical heat in a vacuum, and subsequently sealed them also in a vacuum. The platinum lamp, however, did not achieve success.

The document then proceeds to narrate the difficulties early inventors had met in their efforts to use carbon for electric lamps, and says: "We do not find in the words 'suitably sealed' used in the King patent (British, 1845, No. 10,919) to describe a modification of his lamp for use under water, sufficient warrant for the contention that its structure was to be so radically changed as to substitute a light and compact all-glass globe, with irremovable burner, for the cumbrous apparatus with its column of mercury which he describes in detail."

The decree next takes up the Lane-Fox patents, and remarks in substance that these patents do not show such appreciation of the cause of the disintegration of carbon as would controvert the conclusion that the art was looking elsewhere than to carbon for the burner which should have a future. The Sawyer-Mann patents next come under notice; but they do not seem to be sufficient to stay the progress of the Edison claim. Several lengthy extracts from Edison's patent are then given, after which we read:—

> Edison's invention was practically made when he ascertained the theretofore unknown fact that carbon would stand high temperature, even when very attenuated, if operated in a high vacuum, without the phenomenon of disintegration. This fact he utilized by the means which he has described —a lamp having a filamentary carbon burner in a nearly perfect vacuum. Although all glass globes with leading wires passing through the glass and sealed into it had been used before to preserve the conditions of the interior of a chamber from the effects of leakage at the joints, and although the prior art (including the French patent) indicated that subdivision of the electric light was to be obtained by the use of burners of high resistance and small radiating surface, and although pencils of carbon had been tried in imperfect *vacua*, and found wanting, it was invention, in view of the teachings of the art as to the disintegration of carbon under the action of an electric current, to still select that substance as a suitable material from which to construct a burner, much more attenuated than had ever been used before—reduced in size to the filamentary form, in which economy of construction requires that it must be used, in order to avail of the philosophy of high resistance and small radiating surface—and so to combine old elements that the disintegration due to "air-washing" should be practically eliminated, and the burner thus become commercially stable. It is true that carbon burners still break down, that the improvements neither of Edison nor of other inventors have made them absolutely stable, and in a sense it may be said that Edison only made them more stable than they were before—that it is a mere matter of degree. But the degree of difference between carbons that lasted one hour and carbons that lasted hundreds of hours, seems to have been precisely the difference between failure and success; and the combination, which first achieved the result "long desired, sometimes sought, and never before attained" is a patentable invention.

Considerable space is allotted to the word "filament," and its bearing on the case; the defendant having contended that the complainant should have defined more exactly the size of a filament. But in this they were not upheld by the decision; for we find it there stated that the filament was described with sufficient accuracy. After dealing quite fully with this aspect of the case, the decree proceeds as follows:—

> The second claim may be thus paraphrased: The combination of carbon, filamentary or thread-like in size and properly carbonized, used as an illuminant in an incandescent electric lamp with a receiver made entirely of glass and conductors passing through the glass, and from which receivers the air is exhausted to such an extent that disintegration of the carbon due to the air-washing action of surrounding gases or to any other cause is so far reduced as to leave the carbon practically stable. Defendant's lamps are plainly infringements of the second claim as thus construed.

Next the Canadian patent of Edison comes up for notice; the defendant claiming that the patent in Canada was taken out prior to the American one, and the Canadian statute provides that "when a foreign patent exists, the Canadian patent shall expire at the earliest date at which any foreign patent for the same invention expires." It appears that on March 5, 1880, a patent for the same invention was granted in Sweden; but this became void on March 5, 1883. It was therefore contended for the defendant that the patent expired prior to the commencement of this suit. The decision states that the soundness of the defendant's contention depends on the meaning of the words "where a foreign patent exists," as used in the statute; and it affirms that in the opinion of the Court the meaning is, "that it is there used as covering only foreign patents which exist before the issue of the relevant Canadian patent." Hence the objection is overruled. "It is further urged by the defendant that the suit abated on Dec. 31, 1886, by reason of the dissolution of the complainant consequent upon its merger, at the date named, in the 'Edison Electric Light Company.'" This point is also decided against the defendant, as the Company last named is the legal successor of the original Company, and, as such, has a perfect right to carry forward suits of the latter Company. So, after deciding another minor point raised by the defendant, the decree concludes: "The decree of the Circuit Court is, therefore, affirmed with costs." Just what the costs will amount to can hardly be stated positively by outsiders at the present time, though an item has been going the round of the press lately that this part (that is the legal costs) have been settled by the payment to the General Electric Company of something short of $800.

The decision created some little excitement in the lighting world when it was first announced; but it was not very intense. It will be remembered that up to about a year ago, the three leading competing electric light companies were the Edison, the Thomson-Houston, and the Westinghouse. Then the two former combined, under the title of the "General Electric Company;" and now the fight has been between the latter Company and the Westinghouse. The point the public were most interested in, upon this decision appearing, was the effect thereof on the Westinghouse Company, and whether it would stop their business, or whether they would be only able to continue their work on such lines as the General Electric Company might permit.

By way of answer to this question, the Westinghouse Company recently came out with a "card," which has been printed freely in both the daily and scientific press, announcing their readiness to take orders for their new lamp, to be filled Dec. 1. They announce (and in extra heavy type) that "these lamps not only do not infringe the Edison patent above referred to, nor any of the patents of other companies, but they are fully covered by patents of our own." It is further claimed that the lamp "requires no platinum, and is made in separable parts, so that the incandescent burner can be renewed, and the bulb and other parts of the lamp used over and over again. Furthermore, by means of an important discovery, the burner is rendered stable; its efficiency increased; its life prolonged; and its normal candle power maintained." An additional point claimed in favour of the lamp is that, as the bulb is used over and over again, it will pay to manufacture it in ornamental designs. How far the Westinghouse Company has advanced towards making a commercial success of its new lamp, we can hardly undertake to say; but the card of its President, coupled with the knowledge that the lamp patent has but a short time longer to live, tended to allay public fear. The suit may really be more of a burden than a benefit to the General Electric Company, for it forces on the management some very delicate questions to decide. As an instance, before the amalgamation of the Edison and the Thomson-Houston Companies, the former had started a very large number of sub-companies in the cities and towns throughout the country. These companies would be licensed by the parent Company, and under this Charter they had and have still the exclusive control of all Edison patented appliances for their respective territories. Hence the Edison Company could not sell any lamps or machinery in these cities or towns except through the sub-company (called its licensee); and one of the inducements held out to local capitalists to go into these companies was the prospective great gain to come to the licensee from this lamp suit, as the royalty to be collected from parties in their territory would come to them. Moreover, in a great many of these cities, the sub-Edison companies have had to fight a local company acting under patents of the Thomson-Houston Company, and have freely warned them not to use the incandescent lamp—a warning which, of course, was generally disregarded, as the company against which they were aimed had the Thomson-Houston Company at their back.

Now that the decision has been given, the very important question arises, Where do the licensees stand in the matter, seeing that the two parent companies have combined? Not only so, but in the amalgamation the Thomson-Houston interest seems to have the greater voice in the management of the Company. The sub-Edison companies are anxious to have the General Electric Company force their competitors to stop using the incandescent lamp, in accordance with the expected action of the parent Edison Company, in the event of this favourable decision. However, as in some of these cases the "competitor" is a company authorized by the former Thomson-Houston Company to supply light by the incandescent lamp, it can readily be seen that the case is rather complex; and the General Electric Company is placed between two difficulties. So far they have solved the difficulty by not taking any action. However, the sub-companies are not disposed to submit to this inaction, and already at least one of them—the Boston Edison Electric Illuminating Company—has come out with a card announcing the decision of the New York Court, and stating that it owns the lamp patents for Boston, and warning all persons against using the incandescent lamp bought of outside parties. As this warning is probably aimed at the Boston Electric Company more than anyone else, and as this Company is supposed to be very close to the General Electric Company or its former (in part) predecessor, the Thomson-Houston Company, the outcome of the matter is awaited with very general interest.

COAL GAS: ITS MANUFACTURE, DISTRIBUTION, AND CONSUMPTION.

A Series of Articles for Gas Students.

The Purification of Crude Gas.

(*Continued from p.* 1035.)

We will now deal with the purification of gas by oxide of iron—(hydrated peroxide of iron—$Fe_2O_3, 3H_2O$). Where lime purification is supplemented by the use of this material, the latter is employed for the extraction of sulphuretted hydrogen; and carbon bisulphide and other sulphur impurities are removed in the calcium sulphide box, while carbonic acid is separated in the first and second of the hydrate of lime series. Certain cyanides are also absorbed in the oxide purifier. The methods of arranging the purifiers are various. The more general plan is to use four lime purifiers in rotation, and two oxide purifiers as "catch boxes," to arrest any sulphuretted hydrogen that may pass forward from the last lime box. The material employed is a hydrated peroxide of iron, as above; and a protosulphide of iron is formed on its combination with the sulphuretted hydrogen in the gas, thus—

$$Fe_2(HO)_6 + 3H_2S = 2FeS + 6H_2O + S.$$

The water present does not take any part in the reaction, which, for simplicity's sake, might, perhaps, be better given thus—

$$Fe_2O_3 + 3H_2S = 2FeS + S + 3H_2O$$

The sulphide will decompose on exposure to oxygen (either free or as present in atmospheric air); parting with the sulphur, which falls in the free state and forming the peroxide again, thus—

$$2FeS + 3H_2O + 3O = Fe_2O_3\,3H_2O + 2S.$$

The oxide used may either be a natural bog ore, as obtained in large quantities from Irish bogs, or it may be artificially prepared. The bulk of that used in the purification of coal gas in this country is of the former class. Its preparation prior to use is, as with lime, of great importance, as thereon largely depends its efficiency in the box. This will also be materially affected by the proportion of hydrated oxide present in the ore, and by certain physical conditions that may, and will, vary periodically, and may or may not be more or less under control—such as the speed of the gas and the pressure in the purifiers, the temperature, the consistency and porosity of the mass, and the percentage of moisture present. The resistance offered by the purifying material is of considerable moment to the gas manager, as the amount of such resistance is identical with the increase of back pressure effected in the purifier. To render the material more porous, and thus not only facilitate the passage of the gas through it, but also to allow for the gas a much more ready access to, and intimate contact with, all the particles of the material itself, it is mixed with sawdust. This acts, moreover, as an absorbent of the large quantities of water formed by the reaction in the purifier (as per the equation given above). Were it not for this or some similar absorbent, the moisture present would cause the material to cake and harden, and render it almost useless owing to the great resistance it would offer to the gas; and this would occur long before it had taken up its theoretical equivalent of sulphur. As a matter of fact, it not unfrequently happens in practice that an oxide purifier has to be changed before being fully saturated, on account of the back pressure which it is giving.

The natural bog ore is much more porous than the artificially prepared oxide. While the former may be used without sawdust (although it is usual to mingle with it a small quantity), the latter may with advantage be mixed with its own bulk of that material. The density of the prepared oxide will, of course, vary according to the methods and processes attending its preparation, and will represent an important factor in the utility of the material to the gas maker. The less sawdust needed the better, as buyers of the spent oxide object to the presence of any large proportion.

The readiness with which the fouled material (the sulphide) can be re-oxidized renders oxide of iron an economical and useful purifying agent. Its "revivification," as the process of re-oxidation is termed, may be effected wholly by exposure to the atmosphere; or a continuous process of oxidation may be carried on in the purifier; thus prolonging considerably the period during which the purifying mass will remain active, and continue to take up sulphuretted hydrogen.

By the simpler method of revivification, the fouled material is taken out of the purifier, and left in a heap for a day or so to cool. Re-oxidation commences immediately on contact with the open air; and when the material is new—*i.e.*, has been used only once or twice—this re-oxidation is attended with great heat. After standing for a day or two, the mass is opened out, spread on a drying-floor, and repeatedly turned over until the whole of it has been thoroughly oxidized; the sulphur remaining in the free state in minute particles, and the mass having changed colour from the black sulphide to the reddish-brown oxide. It is then ready for more work, and may be placed in the next purifier available. It may be necessary to damp the material again before using, owing to the heat generated during oxidation having evaporated some of the moisture; but this will depend upon circumstances.

Oxide of iron may thus be used over and over again. After each fouling and subsequent re-oxidation, a certain percentage of free sulphur will be added, until from 45 to 55, or even 60 per cent. and more is present, when the material is readily saleable to manufacturing chemists for the recovery of the sulphur. As the percentage of free sulphur increases after the first or second times of using, the absorbent powers of the mass of material for sulphuretted hydrogen decrease; but not in inverse proportion. Moreover, a high percentage of free sulphur not only represents a decrease of purifying power, but also an increase of back pressure, which, as already noted, may be so pronounced as to necessitate turning off a box. A set-off to these disadvantages is, however, the enhanced saleability of the spent material. The power of oxide of iron to absorb cyanogen has already been referred to. This is variable, and does not follow that of absorbing sulphuretted hydrogen (*Schilling*); while, when the oxide has been used several times, the minute particles of free sulphur present will arrest a portion of the bisulphide of carbon and other sulphur compounds—a power which appears to be largely increased when air or free oxygen is admitted into the purifiers. This will be referred to later on.

As already stated, the bulk of the oxide of iron used for gas purification is a "native Irish oxide," obtained from the well-known Irish bogs. This material varies much, as does also the

artificially prepared oxide, in character and composition, and consequently, in purifying capabilities. "King's Treatise on Coal Gas" gives the following average composition of the richer descriptions of native bog ore:—

Ferric oxide	60 to 70 per cent.
Organic matter	15 to 25 ,,
Silica	4 to 6 ,,
Alumina	1 ,,

As generally used, the material contains 30 to 40 per cent. of water (which is, of course, included in the above figures).

The following analyses of various samples have been kindly placed at the service of the writer for the purpose of these articles. The percentage of moisture is given separately.

Native Oxide.

Moisture	47·64	47·90	44·61	34·40
Ferric oxide	39·42	34·37	41·32	44·32
Organic matter	12·94	17·73	14·07	21·28
	100·00	100·00	100·00	100·00

Another authority gives the following average:—

Moisture	50·00
Ferric oxide	32·00
Vegetable fibre, &c.	18·00

Mr. Norton H. Humphrys, in an interesting paper, entitled "The History of a Heap of Oxide,"* describes as follows the composition of a quantity of Westbury natural clay iron ore used for gas purification:—

	Natural Composition.	Watered, Mixed with its own bulk of Sawdust, and Prepared for Use.
Hydrated peroxide of iron	66 per cent.	49 per cent.
Earthy matter	28 ,,	21 ,,
Uncombined water	6 ,,	15 ,,
Organic matter	—	15 ,,
	100	100

This material, having about 25 per cent. of sandy clay, is very inferior for purifying purposes, and would only be used under favourable purifying conditions.

The following is the percentage composition of a manufactured hydroxide of iron. It is produced as a bye-product in the reduction of an organic body:—

		Dried at 100° C.
Moisture	17·00 per cent.	—
Ferric oxide	77·47 ,,	93·83
Organic matter	5·53 ,,	6·17
	100·00	100·00

The theoretical value of ferric oxide as an absorbent of sulphuretted hydrogen may be calculated (similarly to calcium hydrate) as follows, omitting the equivalent of moisture:—

$$\underset{111\cdot8+47\cdot88}{Fe_2O_3} + \underset{6+95\cdot94}{3H_2S} = 2FeS + 3H_2O + S.$$

$$159\cdot68 : 100 :: 101\cdot94 : 63\cdot84$$

That is to say, 1 lb. of ferric oxide will theoretically absorb 0·63 lb. of sulphuretted hydrogen. ("King's Treatise" gives 0·603 lb., or 6·7 cubic feet, of sulphuretted hydrogen removed by 1 lb. of dry ferric oxide; and therefore a sample containing 40 per cent. of ferric oxide should remove $6\cdot7 \times 0\cdot4 = 2\cdot68$ cubic feet of the impurity per pound of the material.)

The following is a method of ascertaining the percentage of ferric oxide present in any sample ("King's Treatise"): Dry the sample at a temperature not exceeding 160° Fahr. Take 100 grains of the dried sample, introduce it into a platinum crucible, ignite at a moderate red heat, and stir occasionally. Put the residue into a flask, and digest with strong hydrochloric acid; a small quantity of nitric acid being finally added. The digestion is continued until the residue has lost its red colour. The contents of the flask are then diluted with water, filtered, and the residue washed. To the solution add ammonia in slight excess, filter, and wash the precipitate with hot water. Dissolve, precipitate, or filter, and wash and filter well. To the solution add potassic hydrate in excess, filter, and wash the precipitate. Dry the precipitate, and heat it to redness in a platinum crucible. Cool and weigh. The result is the weight of ferric oxide.

Stevenson's method of ascertaining the percentage of free sulphur present in a sample of spent oxide is as follows: In the first case, take every precaution that the whole of the sulphide has been *thoroughly oxidized*, so that all the sulphur contained in the sample may be present in the free state. Then weigh out 100 grains of the sample, dry at 212° Fahr., and weigh again. The difference in weight will be the percentage of moisture present. Place the dried sample in a test-tube having in the bottom an orifice communicating with a small flask which is fixed underneath the tube; and blow into the tube a quantity of liquid bisulphide of carbon. This dissolves out the whole of the free sulphur, which passes down with it, in solution, into the small flask. Prior to the experiment, the flask is dried and weighed. It is provided with a doubly-perforated stopper—one tube communicating with the oxide tube, the other with a water condenser. The bisulphide of carbon is gently driven off by heat applied through a water bath; and, passing through the condenser, it may be collected again in the liquid form, and returned to the stock-bottle. When the whole of the carbon bisulphide has been completely driven off by gently melting the sulphur, the flask is cooled and once more weighed, when the gain in weight represents the quantity of sulphur which has been extracted from the oxide—*i.e.*, the percentage of sulphur present in the sample.

Bale's modified process is designed to lessen the liability to error inherent in the above method. The sample to be analyzed is enclosed in a test-tube of special construction, which is ground into the neck of a sulphur flask which has a small orifice at the bottom opening direct into the flask. The upper end of the tube is connected by a gas-tight tube to a spiral condenser, and continued to a catch-flask, to receive any carbon bisulphide that may have escaped condensation. The weighed sample is then placed in the tube, which, with the flask, has been weighed. Near the top of the oxide tube, but inside the flask, is a small hole. On heat being applied through a water-bath, the carbon bisulphide will be driven off from the flask through the hole in the oxide tube into the condenser, where it is liquefied, and passes down again, drop by drop, into the oxide, through which it passes—dissolving out the sulphur, which is thus washed into the flask below. The process is continuous; and it can be carried on until the carbon bisulphide dropping from the tube into the flask is perfectly colourless—thus indicating that the whole of the sulphur has been dissolved out. The sulphur can then be recovered and weighed, as with Stevenson's apparatus. The merit of this plan is the freedom from smell with which it can be carried on, and the simplicity of the process.

The advantages claimed for oxide of iron as a purifying agent supplemental to calcium hydrate, and as compared with the sole use of the latter, are reduction of the nuisance consequent upon the change of lime purifiers, and greater economy in purification. The latter is effected in two ways. On being worked sufficiently, the material becomes a saleable article, and thus to a great extent repays its first cost. A considerable saving in labour is also claimed for the use of oxide as compared with the employment of lime only. On the other hand, the increased difficulty of disposing of the exhausted material, the labour needed for its revivification, a reputed depreciation in the illuminating power of the gas, and especially as regards the purity in colour of the gas-flame, are points urged by some authorities against the use of oxide, and in favour of lime solely; while the admission of air, or, better still, pure oxygen, in the lime purifier effectively disposes of the nuisance difficulty.

These, then, are some of the *pros* and *cons* on the subject of the employment of oxide of iron in the purification of coal gas. But the more advanced methods of using this material have yet to be mentioned. These embrace the utilization of a continuous supply of oxygen inside the purifier, which, mechanically mixed with the gas in definite proportions, is found to be capable of partially revivifying the oxide *in situ*; thus keeping the material active, and indefinitely prolonging the period during which the purifier will work before becoming inactive. The consideration of the various methods employed, as regards the application of the system to both oxide and lime, must be postponed to the next chapter.

(To be continued.)

* See JOURNAL, Vol. LIV., p. 50.

Mr. William Ewart, of Annan, is closing his connection with the Gas Company on the 31st inst., after a lengthened and honourable career with them as Manager. Mr. James Irving has been appointed to succeed him in office.

New Use for Ammoniacal Liquor.—A farmer of Graaf-Reinet, Cape Colony, has found gas liquor very efficacious for destroying locusts, which are ever, and now particularly, such a plague to South African farmers. The ammoniacal and sulphurous constituents of the liquor, which mixes well with water, render it effective not only for killing locusts, but as an insecticide generally. It has been found a good application for trees infested with American blight; the roots being laid open to some good extent round the tree. In the case of an infested tree thus treated, the insects on the branches died off through, as it is believed, the supply being cut off from below.

Books Received.—"Hazell's Annual for 1893." This is the eighth year of issue of this very useful volume; and it bears many evidences of the determination of the publishers (Messrs. Hazell, Watson, and Viney, Limited) to make it a thoroughly reliable record of the events of the past year in all parts of the globe. Two-thirds of the book, at least, consist of new matter and the remainder has been thoroughly revised up to Nov. 30. "The Water-Meter: Its Difficulties, Types, and Applications." This is a manual of reference and fact in connection with the supply of water by meter, which has been prepared by Mr. W. G. Kent, and issued by Messrs. E. and F. N. Spon. The object of the author has been to provide, for the use of water engineers and others, a means of ready reference to the theory and practice of metering. The text is furnished with side-notes, and is illustrated with large plates. Mr. Kent's book presents a good deal of information in a concise form; and therefore is a welcome addition to technical literature. "Calvert's Mechanics' Almanack and Workshop Companion for 1893." This little, work, which has reached its twentieth year of publication, contains much practical, technical, and industrial information specially prepared for artisans and handicraftsmen, and those who are generally engaged in the mechanical, engineering, and building and constructive trades. It is to be had from the author Mr. J. Calvert, 99, Great Jackson Street, Manchester.

TECHNICAL RECORD.

THE THEORY OF THE MODERN GAS-ENGINE.

At the last Meeting of the Leeds Association of Engineers, Mr. W. Norris, of Lincoln, read a paper on the above subject, of which we give an abstract below.

The author dealt first with the four-cycle gas-engine, and compared it with the best type of modern compound condensing steam-engine; contending that the former was decidedly the more efficient. He stated that Lord Armstrong said some eleven years ago that if the entire heat-energy of a good condensing steam-engine were divided into ten equal parts, roughly speaking two parts would be found to escape by the chimney, one would be lost by radiation and friction, six would remain unused when the steam was discharged, and one only was realized in useful work. In other words, 90 per cent. of the heat-energy of the fuel was lost. Speaking of the losses in the gas-engine, Mr. Norris said the loss of heat to the jacket water depended on the difference of temperature between the gases in the cylinder and the water in the jacket; the extent of surface exposed to the heated gases and the cooling water; the time the gases are allowed to be in contact with the walls of the cylinder; and the thickness of the metal forming the body of the cylinder. In some engines there is a saving of from 7 to 10 per cent. due to the diminished loss of heat by using jacket water at 158° Fahr., against 64° Fahr. It must not, however, be supposed that increase of temperature of jacket water will always conduce to economy. The author showed that increase of velocity of expansion coming more rapidly in combustion gives rise to great pressure and diminished loss of heat through cylinder walls. The loss in discharging the gases at high temperatures could, he said, only be reduced by increasing the range of expansion, and so lowering the temperature of the gases. He went on to show that compression reduces the losses and increases the efficiency in gas-engines by allowing the expansion of the gases to be carried to a much greater degree, and diminishing the surface in contact with the heated gases. If the mixture of air and gas contains more than 66 per cent., or less than 25 per cent. of gas, it will not explode. In the former case, it will not ignite; and in the latter, it burns quietly away. Speaking of the results obtained from a 16 effective horse power Robey gas-engine, Mr. Norris gave the average pressure as 75 lbs. per square inch; terminal pressure, 24 lbs.; efficiency of heat turned into work, 21 per cent.; rejected in jacket water, 44 per cent.; rejected in exhaust, 35 per cent. This was working with gas having a calorific value of 601 British thermal units. The actual heat supplied to this engine amounts to 12,100 thermal units per indicated horse power per hour, which corresponds to 21 per cent. of absolute efficiency. The efficiency of a perfect engine working between the same temperatures as those calculated for this engine would be 81 per cent. The author next alluded to automatic tube ignition, which has been known for some 30 years, although only turned to practical use about ten years ago. After some years of careful experimenting, he had, he said, come to the conclusion that there is no known method of igniting a compressed charge of gas which admits of obtaining the same results as by simply forcing a charge of gas and air into a tube always open to the cylinder. Speaking of gas-engines of larger power, he showed photographs and drawings of an 86-horse effective Robey engine, which, acting in conjunction with a gas-producing plant, will work on a consumption of 1¾ lbs. of anthracite coal per effective horse-power per hour. Speaking of the gas-engine of the future, Mr. Norris said he thought it would have a gradual combustion, or be what is better known as the flame engine. By the aid of a blackboard, he demonstrated what actually takes place in an engine of this type; the various points of cut-off, the comparative low maximum effective pressure, and the very high average pressure being clearly shown.

In the subsequent discussion, Mr. R. H. Wood referred to the difference existing in the use and application of the water jacket in steam-engines and gas-engines; it being essential in the case of the latter, as it was with the Maxim gun. Mr. Drake referred to the difficulty of getting gas of such a uniform richness as to explode at the precise moment the piston was at the bottom of its stroke; and he said he was not sure that the timing-valve was not the best. Mr. Towler thought the steam-engine should hold its own, against even so formidable a rival as the gas-engine, especially in the case of high powers. Mr. Blackburn alluded to the value of a quick expansion in preventing loss of heat through the jacket. Other speakers having commented on the various matters brought forward, Mr. Norris replied; and he was subsequently accorded a vote of thanks for his paper.

OTTO'S PATENT AERIAL ROPEWAYS.

In the Journal for October 11th last (p. 638), we gave an illustrated description of the Otto system of aerial lines for the transport of coal, coke, lime, &c. It may be remembered that its chief characteristic is the employment of two ropes—one being heavy and fixed, for carrying, and the other a light travelling hauling rope. Buckets or carriers fitted with grips, for attachment to the hauling-rope, according to the gradients that have to be surmounted, practically complete the system. They are of different designs, to suit the material to be transported. An important feature in them is the truck or runner; and another is the special form of coupling by which they are attached to the hauling-rope. These are either frictional or positive, according to the gradient of the line; but both are automatically released from the hauling-rope at the unloading station, and allow the buckets to be switched off on to sidings. The design of the stations can be arranged to suit special requirements. As a rule the loading station is on the ground level, and the buckets are pushed along the shunt-rails by hand, and filled by spouts from large storeage bins. The unloading stations are more commonly at a considerable elevation; so that the material transported can be either delivered from bins or on to floors for storeage. The illustrations on the next page show the system in use. They have been prepared from photographs of a ropeway constructed at the works of Messrs. A. Tate and Sons, the well-known sugar-refiners, at Silvertown. This ropeway was designed to transport bags, boxes, or barrels from the top floor of a warehouse across a yard to the wharf-side, and had to be made so that it would in no way interfere with the traffic below. The manufacturers of these ropeways in this country are Messrs. Commans and Co., of 52, Gracechurch Street, E.C.

THE BEHAVIOUR OF ETHYLENE ON EXPLOSION WITH LESS THAN ITS OWN VOLUME OF OXYGEN.

A paper upon this subject was read a short time ago before the Chemical Society by Messrs. Lean and Bone. Previous researches by these authors have been noticed in our columns and as the results now arrived at by them throw some additional light on the combustion of hydrocarbons and their properties as regards the production of artificial light, we give a brief *résumé* of the principal points.

The authors commence by directing attention to the observed fact that, when a mixture of ethylene with about its own volume of oxygen is fired in a long leaden coil, the volume is almost exactly doubled; indicating that the principal result of the combustion is the formation of carbonic oxide and hydrogen, as shown by the following formula:—

$$C_2H_4 + O_2 = 2CO + 2H_2$$

Analysis of the products showed the presence of small quantities of carbon dioxide, some unsaturated hydrocarbon, and also some hydrocarbon which could not be absorbed by fuming sulphuric acid, and which was believed to be methane. When the proportion of oxygen in the mixture was increased to three volumes of oxygen to two volumes of ethylene, no traces of hydrocarbons, either saturated or unsaturated, could be detected in the products of combustion. The authors tried experiments with seven different mixtures, representing a proportion of 50 ranging up to 95 volumes of oxygen to 100 volumes of ethylene. The weakest mixture was not explosive; and with all the others but the strongest, it was necessary to use a little electrolytic gas to start the explosion. The next mixture to the weakest—viz., 65 of oxygen to 100 of ethylene—would not explode in the coil; but it could be fired in a straight wide tube. The weaker mixtures showed a large separation of carbon in the form of soot on combustion; but when 95 of oxygen to 100 of ethylene was reached, this deposit ceased. Incidentally, the authors remark that fuming sulphuric acid has an appreciable effect in absorbing oxygen as well as hydrocarbons; but has no action on hydrogen or nitrogen. On the other hand, alkaline pyrogallol has no effect on ethylene, nor has strong potash solution. From this it would appear that, when analyzing gases, the oxygen should be removed before the hydrocarbons. The products of combustion, taken in the order of the quantity of oxygen present, show a proportion of 5¼ per cent. of unsaturated hydrocarbon in the weakest, which gradually falls till it disappears altogether in the strongest. The methane, commencing at 6 per cent., also decreases, but does not disappear altogether; the proportion in the strongest being 1·01. Carbon dioxide follows a similar course; ranging from 1·6 down to 0·3 per cent. Concurrently, with these decrements, the hydrogen and carbonic oxide exhibit a regular increase; showing that, in the main, the action above instanced took place. Acetylene was determined to be present among the unsaturated hydrocarbons. From the fact that this substance is not produced when methane is fired with the smallest possible proportion of oxygen, the authors conclude that its formation is due to the union of nascent hydrogen and nascent carbon at the very high temperature of the explosion. They also suggest that the presence of methane is due to the action of the heat liberated by the main reaction on some of the unburnt ethylene, thus—

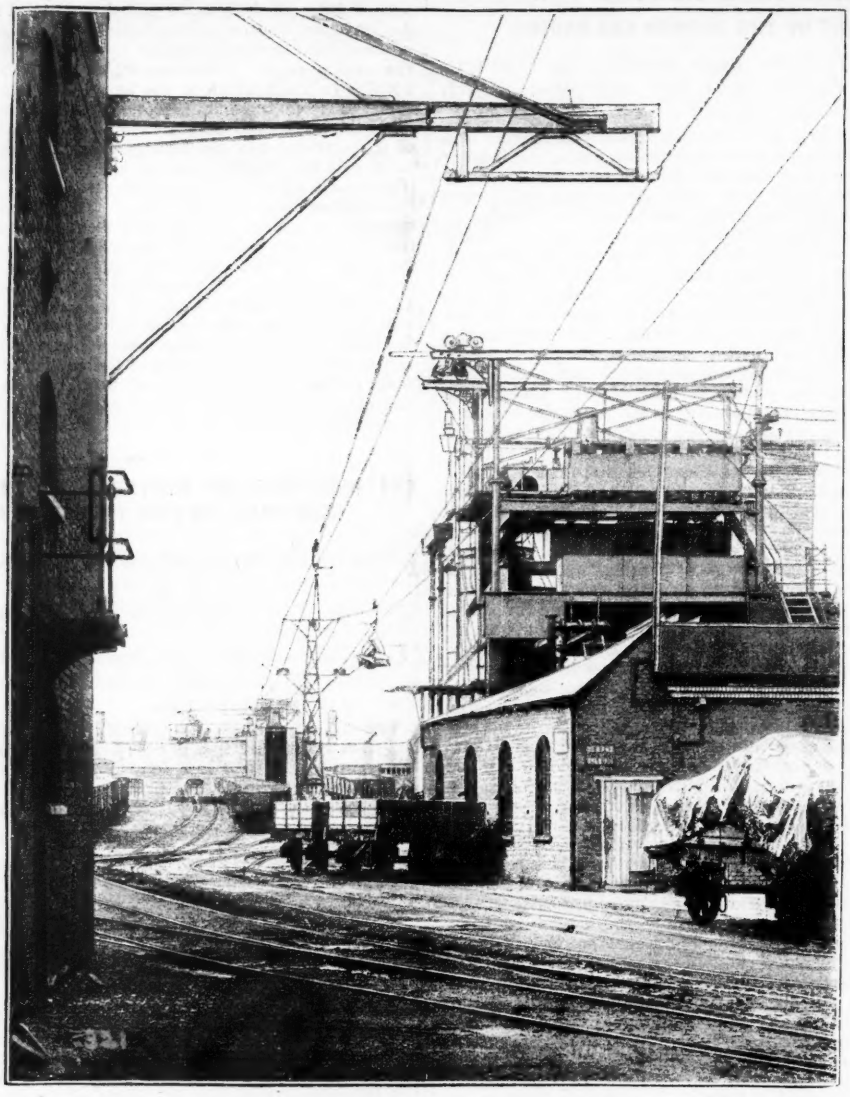
$$C_2H_4 = CH_4 + C,$$

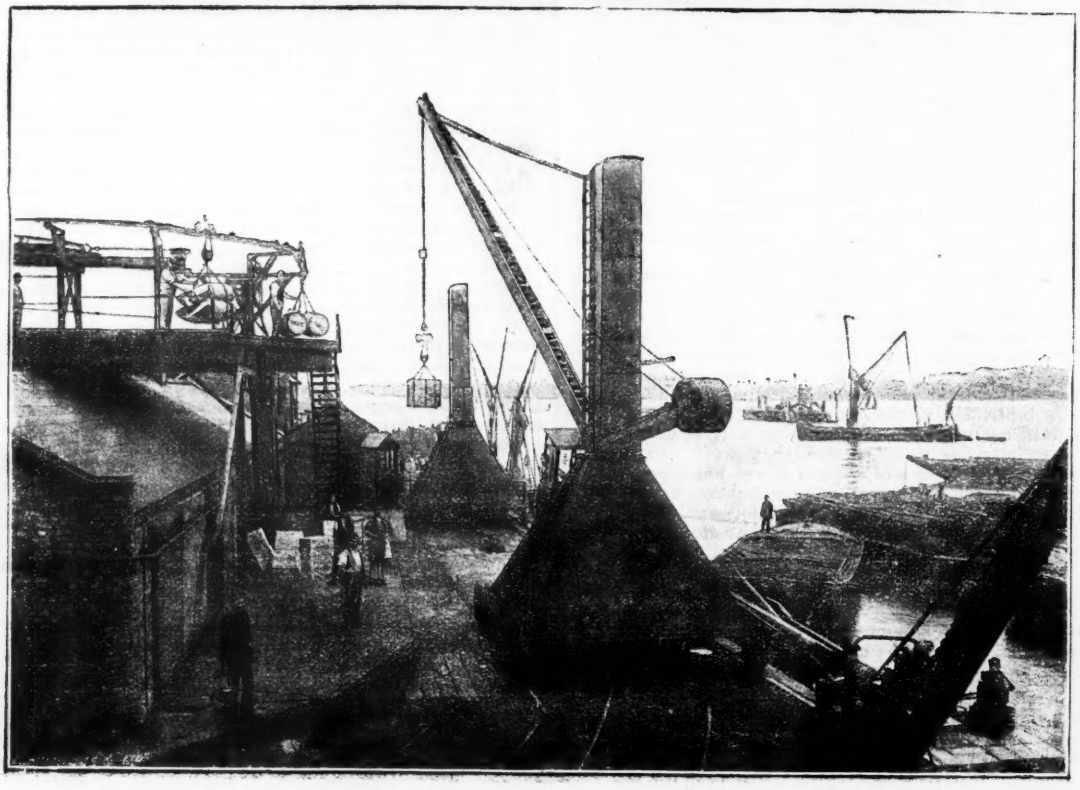
or perhaps by partial oxidation, thus—

$$2C_2H_4 + O_2 = 2CH_4 + 2CO.$$

The Deimel Gas-Lamp has, we understand, now been adapted for outside lighting, and it is claimed that the lamp is thoroughly wind-proof.

OTTO'S PATENT AERIAL ROPEWAYS, AS IN USE AT MESSRS. A. TATE AND SONS' SUGAR-REFINING WORKS, SILVERTOWN.





THE LUMINOSITY OF COAL-GAS FLAMES.

In the number of the *Chemical News* for the 16th inst., there was an article on "The Luminosity of Coal-Gas Flames, Partially Due to the Occlusion of Gases by the Carbon Particles," by Dr. J. LEICESTER, Lecturer on Chemistry and Metallurgy at the Merchant Venturers' Technical School, Bristol. We reproduce the article as a contribution to the literature of a subject which is now engaging much attention.

Davy in 1818 accounted for the luminosity of flame as follows: "The luminosity of flame is due to the decomposition of part of the gas towards the interior of the flame where the air is in smallest quantity, and the deposition of solid charcoal, which, first by its ignition and then by its combustion, increases in a high degree the intensity of the light." Professor Smithells, in his paper on "The Structure and Chemistry of Flames," says: "Air charged with benzene vapour yields a flame in which, after the two non-luminous cones have been separated and the supply of benzene vapour increased, a luminous tip appears in the inner cone; and on further increasing the benzene, this tip extends as a vertical streak of separated carbon. It is luminous for some distance above the inner cone, then cools down, and only becomes incandescent again on passing through the tip of the upper cone. The carbon which is in the solid state must either undergo the usual glowing combustion, or escape from the flame unburned. As it does not do the latter to any appreciable extent, it must burn, and the cessation of its combustion as a solid marks the limit of the yellow or luminous region of the flame." Again, the higher we go in the flame, the greater proportionally is the amount of separated carbon; for we have not only the heat of laterally outlying combustion to effect decomposition, but also that of the lower parts of the flame. The lower part of a luminous flame is accordingly cooler, and contains less separated carbon than the upper. Professor Stokes has shown the separation of carbon, or carbon associated with hydrogen in flames, by its polarizing effect on light. Professor Vivian B. Lewes lays great importance upon the acetylene formed. He says: "In the luminous zone the temperature ranges from 1100° C. to a little over 1300° C. Here the acetylene formed in the inner zone becomes decomposed by heat, with liberation of carbon, which at the moment of production is heated to incandescence by its own combustion and by the combustion of the carbon monoxide and hydrogen, and gives luminosity to the flame. He has shown that oxidation, dilution, and cooling all help to bring about the destruction of luminosity in a Bunsen flame. In other words, the liberation of free carbon is reduced; and therefore the luminosity is diminished.

The various reasons here given refer entirely to the carbon particles being burnt or raised to incandescence by the heat of combustion of other constituents. It has occurred to me that possibly a portion of the luminosity might be due to the nascent carbon particles having the power of occluding certain of the gases; and thus being raised by the heat of condensation to incandescence. As the further study of flames ought to be left to Professor Smithells, I simply lay the suggestion before those chemists who are interested in the subject, and have communicated with him.

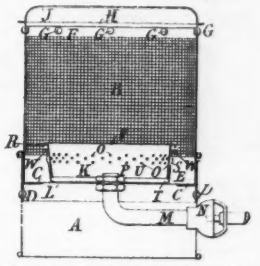
The Expansion of Liquids and Gases.—In a recent paper on "The Laws of Expansion of Liquids, their Comparison with the Laws Relating to Gases, and the Form of the Isothermals of Liquids and Gases," Mons. E. H. Amagat states in the *Comptes Rendus* that the substances examined were water, ether, alcohol, carbon bisulphide, hydrogen, nitrogen, air, oxygen, ethylene, and carbonic acid; the pressures ranging from 50 to 3000 atmospheres, and the temperatures from 0° to 200° C. For both liquids and gases, the isothermals present a slight curvature turned towards the axis of abscissæ. The angular coefficient increases with the temperature. This effect is specially pronounced in the liquids, where it corresponds to a widening out of the network, well exemplified in carbonic acid, in the part corresponding to the lower temperatures. This widening out gradually disappears as the temperature rises; in the lighter gases, the variation with the temperature is very small.

The Loss of Head of Water Flowing in Cast-Iron Pipes.—A simple formula for ascertaining the loss of head of water flowing through clean cast-iron pipe, where the velocity is between 2 and 4 feet per second, has been proposed by *Engineering*. When the velocity is 3 feet per second, the head required to maintain such a flow is equal approximately to the length of the pipe in feet divided by 25 times the diameter of the pipe in inches; and the discharge in cubic feet per minute is very nearly equal to the square of the diameter of the pipe in inches—the error really being less than 2 per cent. For a velocity of 1 foot per second less than 3 feet per second, the head must be reduced one-half, and by a proportionate amount for intermediate cases. For a velocity of 1 foot more than 3 feet per second, the head must be increased 0·7 times that required for a 3-feet velocity; intermediate values being determined by interpolation in the usual manner. For rough pipes—that is to say, those which are in actual use—half these figures will probably be a better approximation to the real condition.

REGISTER OF PATENTS.

Portable Gas-Fire Stove.—Bell, G. M., of Bradford. No. 19,995 Nov. 18, 1891.

This gas-stove is designed to provide for the gas being intimately mixed with a proper proportion of air and superheated before combustion.



The lower part of the stove is formed of a sheet-metal cylinder A; and the upper part B is made of wire-gauze, also of cylindrical form, and arranged to fit inside A and rest upon the internal flange C, secured by the rivets D to the casing. A ring or binding piece of sheet-metal E is secured to the bottom of B; and a similar ring F is also secured at the top by the rivets G. A disc or top H rests upon the inner heads of the rivets; and the ring F is continued up, and bent over, to form an annular support J, to hold a dish of water or the like. The combined mixing chamber and burner K (supported on the disc L) is supplied with gas and air by the pipe M, fitted with an ordinary Bunsen or atmospheric burner attachment N. A number of perforations O are made in the annular side P of the chamber K, through which the gas and air issue to be lighted outside. The aggregate area of the perforations is considerably greater than the area of the gas and air supply pipe; so that the gas issues from the numerous perforations under comparatively slight pressure. Besides affording every facility for perfect combustion, the flame thus inclines or impinges against the side and overhanging flange or rim R of the chamber and heats it. This heat is conducted generally to the walls of the chamber; and the gases inside are consequently heated, and issue from the apertures O in a condition highly favourable to combustion. A fringe S of asbestos fibre is preferably placed outside round the chamber K over the perforations; and this, when heated, becomes incandescent, as usual with gas-fires. To secure the fibre in position, the bottom and lower part of the side of the chamber is formed by the dish T; and the perforated annular piece U fits in the dish. The lower ends of the fibres S are wedged between the inside of T and the outside of U; while the upper ends of S are secured in a similar manner round U by the annular piece W. The top of the chamber is formed by the disc V, flanged over the top of U.

Gas and Hydrocarbon Engines.—Seck, W., of Oberursel, Germany. No. 22,834; Dec. 31, 1891.

The object of this invention is to provide a gas-engine, the working parts of which are so arranged as to enable their being lodged in a closed casing partially filled with oil and water, or other lubricating substance. The patentee claims that thereby he not only obtains great economy of space, but also complete self-lubrication of the working parts, and further the engine offers the great advantage that no injury can be done to any persons by the working parts, as they are all enclosed in the casing. In general, the working order of the engine is the same as that of other known constructions; the gas is drawn into the engine by the suction of a piston, together with atmospheric air, which becomes mixed with the gas; and the mixture is ignited by a flame—an exhaust-valve serving to discharge the products of combustion.

The principal new features of the engine consist, first, in the peculiar valve motion operated by an eccentric mounted on the crank-shaft; secondly, in the peculiar arrangement of the regulator controlling the valve motion; and, thirdly, in the combination of the main parts of the engine with an enclosing case.

The valve motion consists of a set of gear-wheels, two of which (one fast and one loose) are mounted on the crank-shaft, the crank of which operates the piston through which the suction of gas and air is performed. Parallel to the crank-shaft, a fixed stud or shaft is arranged in the machine, which carries two gear-wheels secured to (or made integral with) each other. These gear-wheels are loose on their stud, and mesh with the two wheels on the crank-shaft. The size of the four wheels is so proportioned that the loose wheel on the crank-shaft makes only one revolution while the shaft makes two. Secured to the loose wheel on the crank-shaft is an eccentric, which has a bearing against a roller or sheave connected by a rod to the exhaust-valve of the explosion chamber of the engine. By this means, the exhaust-valve is normally lifted once during every two revolutions of the crank-shaft; but, in the beginning of the operation, the sheave or roller which controls the exhaust-valve may be shifted, so as to receive a lift by the eccentric during each revolution of the crank-shaft, in order to provide an escape for the mixture of gas and air before the explosion. The regulator preferably is centrifugal; and its varying positions are transmitted to a system of rods by which a stop is thrown into engagement with a notch or pin of the exhaust-valve rod, whereby the valve-rod and valve are temporarily lifted out of control of the eccentric till the regulator has returned into its normal position, whereby the engagement of the stop and notch is released, and the play of the valve set free to continue.

Regulating the Pressure of Gas and other Fluids.—Strathern, A. M. and A. G., of Glasgow. No. 836; Jan. 15, 1892.

This invention has reference to the construction or arrangement and combination of the parts of valves and valve-fittings for governing or regulating the pressure or rate of flow of fluids, such as illuminating

gas, in passing from the gasholders to the delivery-mains, or from stations or districts to street mains or pipes.

Fig. 1.

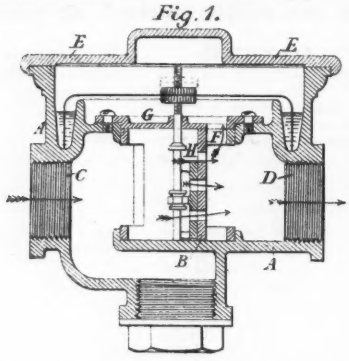


Fig. 2.

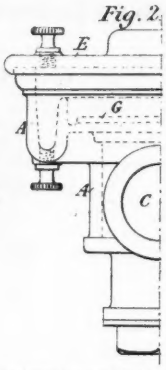
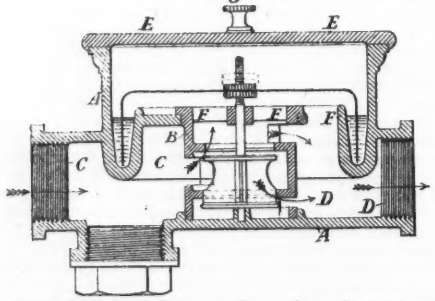


Fig. 1 is a sectional elevation of a valve and fittings for regulating the supply pressure of illuminating gas. Fig. 2 is a half end elevation at right angles to fig. 1. Fig. 3 shows a double-beat or nearly equilibrium valve and its fittings.

In applying these improvements to gas-governors, a usual outline construction of vessel A is used, having an inlet-chamber orifice C and an outlet-chamber orifice D, and a separating partition B or partitions between them. The gas can thus only pass through the valve connections and this division B, having a luted seal annular pocket chamber into which the mercury, glycerine, or other liquid is poured through a screw plug orifice, and drawn off when required through another plug orifice. A screwed-on cover-plate G is fitted between the valve chamber and the bell-float; and a portable or removable cover E is fitted over the governing vessel A. The pressure-weights might be mounted on the spindle inside the vessel A (as shown dotted), instead of outside as usual.

Under the arrangement shown in figs. 1 and 2, the regulating-valve would be formed as a slide-valve, working against a vertical valve-partition B, formed in a hollow cylindrical seating separating the gas inlet close chamber C from the outlet chamber D. The valve would be connected by a projecting slotted lug to the lower square collar end of the actuating vertical spindle; and the valve would preferably be formed of a channel shape with its projecting edges working in channel guides H. This valve is shown as formed with two ports through its face, acting against the seat or vertical partition B, formed with three ports at a short distance apart over each other. The action is as follows: The gas entering from the inlet orifice chamber, which is always greater in pressure than in the outlet chamber, passes through the ports in the valve-seat B to the outlet chamber opening D of the governor. The pressure, after passing the valve-seat B, also through the passage F, acts on the regulating bell-float, actuating the regulating-valve. If the pressure in the delivery chamber D increases beyond that of the loaded bell-float, the latter will rise and raise the valve-spindle and valve, so that bars or solid face parts between and on each side of its ports will cover or partially cover the three ports on the valve-seat or vertical web B, and thus shut off (partially or entirely) the gas supply until the pressure has been again reduced on the delivery side of its seat B. It will then fall again to uncover the gas-supply ports, until (in its lowest position) the valve-port will be in line with the lower port of its seat B; and its upper solid cover part will be below that of the upper port, or at any intermediate position, to regulate the pressure.

Fig. 3.



Under the arrangement shown in fig. 3, the valve-seat casing may be made in the form of an annular chamber B, fitting into the case A at top and bottom, and with a port formed on it through which the gas would enter. The valve consists of two horizontal discs mounted on the vertical spindle which would work within a footstep guide at its lower end; and the discs would work up against annular seats formed on the annular valve chamber B, so that the gas would pass through between the seats and discs, when the latter were lowered, and escape by port passages to the outlet chamber D, and through the hollow spaces F, in the cylinder B, to act on the diaphragm shown. But when the pressure increased in the delivery chamber D beyond that of the weighted holder, the horizontal discs would (by the rising of the holder and valve-spindle) close against their seats, and prevent or diminish the supply of gas passing through the governor.

Gas-Furnaces.—Newton, H. E., communicated from R. N. Oakman, of Greenfield, Mass., U.S.A. No. 845; Jan. 15, 1892.

This invention relates mainly to a method and furnace for heating large sheets or plates of metal, or other articles, by means of gas-flames; the object being to provide for evenly and uniformly heating a furnace of large horizontal area by gas-flames passing alternately in opposite directions both below and above the broad floor or hearth. The flames may be first introduced below the hearth, and then passed above it to the escape-flues; or they may be first passed above the hearth, over an interior crown, and then below the hearth to the escape-flues. In the latter event, the hearth is enclosed, so as to form a muffle. In either case, it is preferable to introduce the flame upon opposite sides of the hearth, and pass then alternately in opposite directions through adjacent parallel flues, either below or above the hearth, and thence conduct the waste products to the escape flues, either above or below the hearth. Uniform heating is thus secured throughout the entire area of the broad hearth or heating chamber; so that large metallic plates or sheets may be evenly heated, for tempering, annealing or other purposes, and improved results obtained. Fuel gas is preferably used—composed of water gas, or a mixture of water gas and producer gas, or it may be, producer gas alone; and the gas is intimately mixed with the air under pressure in the burners.

Gas-Producing Plant.—Oakman, R. N., of Greenfield, Mass., U.S.A. No. 9114; Nov. 19, 1892.

This invention relates more particularly to the manufacture of "producer gas;" the object of the invention being "to provide a generator in which gas of a more uniform character will be produced continuously in a more economical manner than heretofore, from soft bituminous coal." In carrying out the invention, use is made of the "down draught," as described in the specification granted to Burdett Loomis, No. 15,983 of 1888.

Fig. 1.

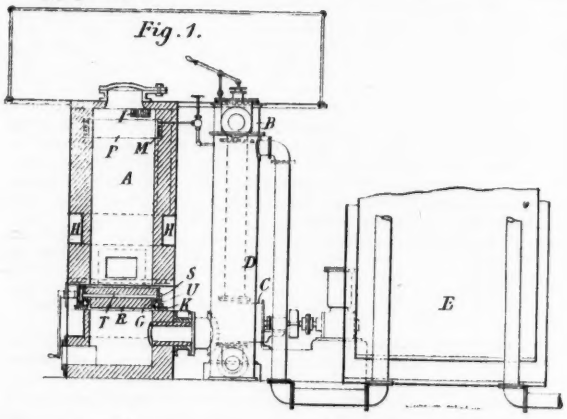
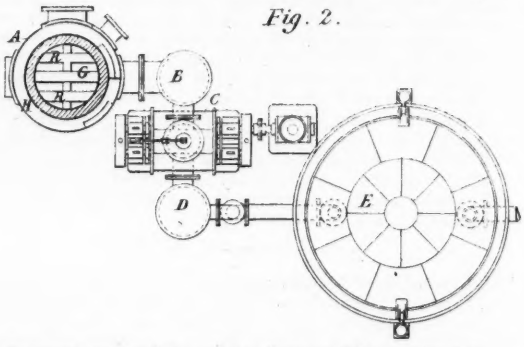


Fig. 2.



A is the generator; and B, a cooler of any suitable construction. C is an exhaust apparatus, preferably mechanical. D is a scrubber of any construction; and F is a gasholder. The gas is produced in A; and while hot, it is drawn by the exhauster from the generator, up through the cooler B, where it renders up its caloric (more or less) to heat water in the cooler, and produce steam, which is used in the production of the gas. The cooled gas is then forced by the exhauster, acting as a force-pump, up through the scrubber D, to be washed, and finally delivered to the holder E, to be stored for subsequent use. The gas is produced partly by raising coal to a state of high incandescence, and partly by the introduction into the incandescent fuel of super-heated steam. The generator consists of a cylindrical metal shell, lined with fire-brick, and having a charging opening at top, a grate G, and a gas-exit from the ash-pit, as heretofore. In the walls of the generator, around the ash-pit, and also around the hottest part of the generator, air-passages G and H are formed, in which the air to support combustion is heated. The passage G is provided with an external air-inlet; and it is connected with the passage H by a vertical shaft. The passage H is in connection, by a vertical shaft and an opening I, with the interior of the generator; so that the air drawn in, under the influence of the exhauster, will be more or less heated before it enters the generator. In a recess in the upper part of the internal wall of the generator, a coil of pipe P is placed, in connection with the cooler B. In this coil, the steam generated in the cooler (which thus serves as a steam generator) is superheated before it escapes by the nozzle M into the generator. The coil of pipe is protected from the destructive action of the flame in the generator, by thin plates of refractory material. In the manufacture of gas, ashes are of necessity formed at the bottom of the fire, and require to be removed from time to time. In order to do this without arresting the production of the gas, a moveable grate is employed, which is occasionally agitated, in order to loosen the ashes, which then fall through the grate into the ash-pit. The grate is formed with bars R, of refractory material, and flanged metal segments S, braced together by bolts T, which pass through both segments and bars.

The front segment is provided with a toothed sector, into which gears a wheel mounted on an axle, which passes through a stuffing-box attached to the shell of the generator, and provided with a handle by which the grate may, from time to time, be oscillated to loosen the ashes. The grate rotates on balls U, which run on a flanged ring K, carried by the walls of the ash-pit. Stops are provided on this ring, to prevent the movement of the balls beyond a certain distance; and stops are also arranged to limit the travel of the grate to the length of the toothed sector, so that the driving pinion shall not get out of gear. The shell is formed with a door of sufficient width to allow of the grate and its supporting ring all being withdrawn, in order to renew the bars from time to time. Although this plant is primarily intended to make producer gas, it will be evident that it may be used to make both producer gas and water gas.

Gas-Engines.—Simon, R., of Nottingham. No. 926; Jan. 16, 1892.

This invention relates to the construction and employment of a rotating worm or spirally-grooved boss on a gas-engine shaft for the purpose of holding open the exhaust-valve, and of permitting it to close automatically (after any desired number of revolutions) at any desired point of the cycle, with the object of obviating or diminishing the labour of starting the engine.

For this purpose, the patentee proposes to employ a swing lever (or its equivalent) in combination with a rotating worm-wheel on the driving-axle or other rotating part of the engine, and gear therein a runner, carried on a swinging frame or lever affixed to the frame or bed of the engine. The runner works in the worm-wheel; and a pin on the frame or lever keeps the exhaust-valve open, by means of a lever in any other convenient way. When it is desired to start the engine, the swinging frame is pushed back to allow the runner to enter the worm-wheel; and in this position, the exhaust-valve is held open. If the fly-wheel be now turned—there being no resistance from compression in the cylinder—it is easy to turn it round several times to acquire momentum, so that when the runner runs off the worm-wheel, the fly-wheel has sufficient momentum to perform the return stroke with little help on the part of the attendant, and the engine will start.

The same effect may be obtained in various ways. The exhaust-valve may be held open more or less wide, according to the depth of the grooves in the worm-wheel; and the number of the grooves may be varied to determine the number of turns the fly-wheel is to make before commencing compression. But the essential part of the invention is the rotating worm-wheel in combination with mechanical arrangements to hold the exhaust-valve open. The patentee also proposes to let the bottom ends of the spindles of vertical valves of gas-engines rest in grease cups, in order to diminish the noise of impact.

Gas Engines and Motors.—Redfern, G. F.; communicated from La Société Anonyme des Moteurs Thermiques Gardie, of Nantes, France. No. 16,413; Sept. 13, 1892.

The claims for this invention are for (1) An improved motive power apparatus, in which the motive force is supplied by the combustion under constant pressure and the expansion of a mixture of gas and air both compressed previously and heated before use by the products of combustion escaping from the exhaust. (2) A cupola-furnace gas generator, working with or without a grate, under a pressure varying from 6 to 12 kilos., and adapted to be charged with fuel under pressure; so that, when at work, the generator will supply gas of constant composition, in consequence of its high internal temperature and the constant height of the fuel. (3) The combination with a gas engine or motor of a regenerator for utilizing the heat of the products of combustion. (4) The construction and arrangement of the working cylinders and pistons as described, so as to fulfil two essential and usually opposed conditions—viz., working at the highest possible temperature, and efficient and economical lubrication of the parts moving with friction. (5) In motive-power apparatus of the kind described: (*a*) Effecting the distribution by means of valves arranged as described, so as to allow of altering, by the regulator or by hand, the quantity of air and gas introduced and the direction of rotation; and (*b*) automatically starting the apparatus by the natural action of reserves of gas and of the parts of the machine, or, if necesary, by means of a small steam-boiler provided with a small steam air-compressor. (6) The production of steam at high pressure for supplying the cupola-furnace gas generator, and for starting the steam air-compressor, by means of a jacket round the upper part of the cylinders. (7) Automatically lighting the explosive charge, by means of incandescent surfaces of metallic plates.

APPLICATIONS FOR LETTERS PATENT.

22,228.—Gozzard, A., "Gas or oil consuming burners." Dec. 5.

22,229.—Gould, H. J., and Bennett, J. W., "Gas-engines." Dec. 5.

22,331.—Neilson, D., "Stopcock for underground pipes for water or other fluids." Dec. 6.

22,512.—Padgham, G. H., "Gas and petroleum engines. Dec. 8.

22,535.—Cowler, F. E., "A gas-fire kindler." Dec. 8.

22,545.—Charter, A. E., "Lighting, regulating, and extinguishing lamps." Dec. 8.

22,602.—Dempster, R., "Manufacture of sulphate of ammonia and liquid ammonia." Dec. 9.

22,688.—Ormiston, J. W., A. R., and J., "Making producer gas." Dec. 10.

22,767.—Cross, T., "Distribution of liquor in ammonia scrubbers or washers." Dec. 12.

22,780.—Moss, G., "Increasing the illuminating power of lamp-flames." Dec. 12.

22,855.—Bellamy, F. C., "Gas-meters." Dec. 12.

22,891.—Scott, J., and Halley, W. S, "Burner for gas-fires and other purposes." Dec. 13.

22,941.—Willis, W., Humphery, E. J., and Smith, W. H. "Production and use of light." Dec. 13.

22,969.—Knieling, H., "Gas-making apparatus." Dec. 14.

23,008.—Fielding, J., "Gas or oil motor engines." Dec. 14.

23,173.—Cowan, W., "Preventing irregularities in the registration of station and other large wet gas-meters." Dec. 16.

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Friday, Dec. 16.

(*Before the* Master of the Rolls *and Lord Justices* Lopes *and* Kay.)

London County Council, Appellants, v. Assessment Committee of the Woolwich Union, Respondents.

The Assessment of Sewage Pumping Stations and Machinery.

This was an appeal by the London County Council from the judgment of the Queen's Bench Division upon a case stated by Quarter Sessions on appeal against a poor-rate. The London County Council were rated as occupiers of certain hereditaments described as works, buildings, and land (other than sewers) known as the northern outfall deodorizing works, forming part of the Metropolitan main drainage system, at a sum of about £30,000 as the gross estimated rental, and about £27,000 as the rateable value. The appellants were incapable of deriving a profit from their occupation; and if the works, &c., were not used in connection with the drainage system, but were disconnected therefrom, and applied to any other use, the gross rental would be £1200, and the rateable value £1000. The respondents, the Assessment Committee of the Woolwich Union, contended that the appellants must be assessed in respect of the works, &c., upon the basis of the annual rent which the appellants would pay for them, as part of, and connected with, the main drainage system, if they were not the owners in possession. The appellants contended that they were not rateable at all in respect of these works; but, if they were, that they should be assessed upon the annual value of the works if these were not used in connection with the sewerage system, but were entirely disconnected therefrom. The Court of Quarter Sessions, as reported in the Journal for Dec. 8, 1891, p. 1051, affirmed the rate, and the Queen's Bench Division dismissed the appeal upon the ground that it was covered by the decision of the Court of Appeal in *Mayor, &c., of Burton-on-Trent v. Assessment Committee of Burton-on-Trent.*

Mr. Horace Avory and Mr. W. C. Ryde appeared for the appellants; Mr. Littler, Q.C., and Mr. W. Sinclair Cox for the respondents.

The Court allowed the appeal, upon the ground that the case was governed by the decision of the Court of Appeal in *London County Council v. Assessment Committee of West Ham Union.** The works now in question were in the same position as the sewers in that case; the County Council having no power, under the statutes, to become tenants of the works, and there could be no other tenants of them, as the appellants had no authority to let them. The case was distinguishable from the Burton-on-Trent case, which influenced the Divisional Court, because there the Corporation could have become tenants of the land and buildings, and therefore could be taken into account as possible hypothetical tenants. The appellants therefore were not rateable in respect of these works and buildings.

London County Council, Appellants, v. Assessment Committee of St. George's Union, Respondents.

This was a similar appeal by the London County Council; the appellants having been rated as occupiers of certain hereditaments described as "land, buildings, pumping-station, and machinery" at Grosvenor Road, on the Thames Embankment.

Mr. Horace Avory and Mr. W. C. Ryde represented the appellants; Mr. Meadows White, Q.C., and Mr. Danckwerts, the respondents.

The Court allowed the appeal, upon the same ground as in the last case.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Tuesday, Dec. 20.

(*Before Mr. Justice* North.)

In re The Buenos Ayres Water Supply and Drainage Company, Limited.

This was a summons in the voluntary winding up of the above Company by the Liquidator, that he might distribute among preference shareholders of the Company bonds of the Argentine Government to the nominal amount of £3,000,000, subject to the reservation of a proper amount to meet the contingency of certain ordinary shareholders, the plaintiffs in two actions in which the Company are parties succeeding in establishing a claim against the concern. An arrangement had been come to between the Company, its creditors, and different classes of shareholders, and the Argentine Government, by which the Government were to take over the undertaking of the Company in consideration of payment in Argentine Government 6 per cent. bonds to the nominal amount of $25,000,000, to be distributed according to a scheme of arrangement, which was drawn up under the Joint-Stock Companies' Arrangement Act, 1870. It had been alleged that the scheme had been brought about by fraud against the ordinary shareholders; and those who made these allegations instituted two actions early last year against the Company, the Directors, and Messrs. Baring Bros., claiming to have the arrangement set aside, or, in the alternative, damages against all the defendants. The scheme came before the Court on petition, for its sanction. The petition was opposed by the shareholders who had brought the action; but Mr. Justice North gave his sanction without prejudice to the rights of the complaining shareholders to damages in their respective actions. The petition was taken to the Court of Appeal; and the Lords Justices confirmed the decision of Mr. Justice North. The Liquidator had given notice to the plaintiffs in the two actions of his intention to make the present application. He suggested that debentures to the nominal value of £350,000 should be retained for the purpose of meeting any possible claims of the dissatisfied shareholders; and the remainder of the £3,000,000 be distributed among the preference shareholders in accordance with the scheme. Such bonds, to the nominal amount of £3,000,000, were now receivable by the Company over and above what

*See Journal, Vol. LIX., p. 1017.

was required to satisfy the rights of the debenture-holders under the arrangement.

Mr. COZENS-HARDY, Q.C., and Mr. CARSON appeared for the Liquidator; Mr. BUTCHER attended on behalf of the plaintiffs in one of the actions.

Justice NORTH sanctioned the proposed distribution—bonds to the nominal amount of £750,000 to be set aside in two sums, in the proportion of 9 to 34, to meet the claims of the respective plaintiffs in the two actions.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Monday, Dec. 19.

(*Before Mr. Baron* POLLOCK *and Mr. Justice* CHARLES.)

The Local Government Board v. The Staines Board of Guardians.

The ATTORNEY-GENERAL (Sir C. Russell, Q.C., M.P.), and Mr. SUTTON moved for a *mandamus* against the Guardians of the Poor at Staines, as the Sanitary Authority, for not obeying an order of the Local Government Board, which directed them to carry out a scheme of drainage at Sunbury, one of the "contributory places" of the Union within the meaning of the Public Health Act, 1875. It was stated that there had been an inquiry by the Local Government Board, who had directed a sewage scheme to be adopted. The Union had no legal defence to the order; but they objected to carry it out on the ground of expense, and also because the scheme was unnecessary.

A rule *nisi* was granted.

MISCELLANEOUS NEWS.

THE FAILURE OF THE ELECTRIC LIGHT IN THE CITY.

In the JOURNAL last week (p. 1099), we briefly recorded a serious stoppage of the electric light in the City on the evening of Sunday, the 18th inst.; and further particulars in regard thereto have since come to hand. On Tuesday morning we received from the Secretary and General Manager of The Gaslight and Coke Company (Mr. J. Orwell Phillips) a copy of the report made to him respecting the occurrence by one of the Company's District Inspectors—Mr. S. J. Ball. He stated that, at seven o'clock in the evening, a communication was received from the City Police to the effect that a considerable portion of the City was in darkness, in consequence of a failure of the electric light; and that he at once called out men who, under his supervision, lighted the gas in the following streets: Aldersgate Street, Newgate Street, Fore Street, Coleman Street, Old Bailey, Ludgate Hill, Golden Lane, Long Lane, Barbican, Smithfield, Aldermanbury, Finsbury Pavement, Old Jewry, Redcross Street, Gresham Street, London House Yard, and St. Paul's Churchyard. Up to the time of finishing his inspection (10 p.m.), the electric light was still out; and consequently he left the gas-lamps burning. He added that no intimation was given by the Electric Light Company, as it appears they should have done in accordance with arrangements, until the gas-lamps were lighted. This was by no means the first trouble experienced with the new system of lighting, although, of course, all mention of failures or inefficient working have been carefully excluded from the papers. We learn from a trustworthy source that, on the 14th inst., all the lamps in Moorgate Street were as nearly extinguished as they could possibly be—burning quite low, and then flashing up again, and never giving the same amount of illumination for five minutes together. These vagaries went on for four nights; but in the previous week all the lamps on one side of the street went completely out for a few minutes after ten o'clock. On the evening of the 15th inst.—a fine, bright evening—about six o'clock, although the electric lamps were burning at their full power, every alternate gas-lamp in the street was in use, doubtless by way of precaution; for on the following morning gangs of men were at work (two to each lamp) searching for the fault, which they hoped to find before permanent injury was done to the lamps. Close by, in London Wall and Fore Street, the lights all went out after midnight about a fortnight ago; and the whole place was left in utter darkness—nothing could be seen. It seems that there are three lamps at the back of the Bank of England, in Lothbury, which are specially bad. The thoroughfares named are, of course, comparatively deserted at ten and twelve o'clock at night, or public attention would have been attracted to these lapses, and some comments thereon made in the Press. This is the state of electric lighting in the City of London, after years of waiting and experiment, and with machinery and every appliance of the newest and best.

THE ELECTRIC LIGHTING MUDDLE AT WINDSOR.

Under the above heading in the JOURNAL for Nov. 1, allusion was made to the curious position in which the Windsor Town Council and the Windsor and Eton Electric Light Company found themselves, owing to the latter body having proceeded with the construction of their works without having first satisfied the Board of Trade, in accordance with the requirements of their Provisional Order, that they had sufficient capital or means to carry out the work, and to continue the supply of electricity for a reasonable period. The difficulty was further accentuated by the Company sending to the Council a month's notice of their intention to lay down the distributing-mains. In reply to an inquiry by the Town Clerk, the Board of Trade expressed their inability to advise the Corporation as to what they should do in the matter; but they intimated that it did not appear to them that the undertakers were in a position differing from that of other persons who desired to break up the streets under the control of a local authority. The Company carried their intention into execution; and, in consequence of this, a meeting of the Council, acting as the Urban Sanitary Authority, was held on Friday, the 9th inst., to consider "the breaking up of Peascod Street by the Windsor Electric Light Company, or some persons on their behalf, and to give such directions as may be deemed advisable in reference thereto." The situation was fully explained by the Mayor (Mr. J. Gane) and Mr. P. Lovegrove. The last-named gentleman said that the only notice received from the Company was dated Sept. 21; and in this they stated that they proposed to lay mains, construct manholes and drawboxes, and otherwise exercise the powers granted to them; but on behalf of the Council, notice of disapproval had been served. Only about five weeks previously, the Board of Trade informed the Council that the Company had not complied with their requirements; and no communication had since been received. Of course, the permission of the Council would not be required, if the conditions of the Order had been fulfilled. Mr. Hollis expressed the opinion that the Company had made "a very impertinent and cheeky sort of affair of it altogether." Mr. Martin remarked that, as there was some doubt as to the stability of the Company, he had particularly inquired the amount of their subscribed capital, and was surprised to find it was only £1500. His own private installation cost more than double that sum; and how they could expect, with such a capital as this, that the Corporation would give them a monopoly over the borough, was astonishing. Mr. Fox asserted that there was not a single electric lighting company who had ever been able to comply with the requirements of the Board of Trade, though one or two corporations had done so; and the Board of Trade knew that it was impossible, and they winked at it. Mr. M'Closkie considered the whole thing laid in a nutshell—Had the Electric Light Company in what they had done injured the ratepayers of the borough? Mr. Bampfylde followed this up; but Mr. Hollis very appositely remarked that such argument amounted to this, that if a company or anyone else did wrong and they were not stopped, the Council were to take no notice of it. In answer to a question, Mr. Lovegrove stated that, assuming the Company had not fulfilled the conditions of their Provisional Order, it might be revoked. Another course was to proceed against them under the 149th section of the Public Health Act, which provided that any person who, without the consent of the Urban Authority, wilfully displaced the pavement, stones, materials, &c., of a street should be liable to a penalty not exceeding £5, and to a further penalty not exceeding 5s. for every square foot displaced. A third remedy was under the General Highway Act, in which there was a similar provision, and subject to the same penalty. Then a more effectual remedy was an injunction in the Court of Chancery; and, under that remedy, they could be made to take up all their wires and to put the pavement as it was originally. The fifth remedy was to indict them at Quarter Sessions for a common law nuisance for disturbing the highway. The Town Clerk (Mr. G. H. Long) suggested that, under the circumstances, they should take the Public Health Act as the starting point, and see what effect that had. Resolutions were ultimately passed instructing the Town Clerk to proceed against the Company under the Public Health Act, but only asking for moderate penalties. In pursuance of these instructions, action was taken; and the matter came before the Borough Magistrates on Monday of last week. From the evidence adduced, it appeared that the Company, in carrying out the works, had displaced 4711 square feet of pavement, and they had, by their breach of the local regulations, rendered themselves liable to maximum penalties amounting to upwards of £1182. The Bench, however, took a lenient view of the matter, and inflicted a fine of £2 and another of £9 16s.; the latter sum representing a halfpenny per foot for the area of pavement disturbed. The Company had also to pay the costs of the proceedings.

THE ELECTRIC LIGHTING QUESTION AT TAUNTON.

Board of Trade Inquiry.

On Friday, the 16th inst., an inquiry on behalf of the Board of Trade was held in the Shire Hall, Taunton, by Sir T. W. P. BLOMEFIELD, Bart., and Major CARDEW, R.E., with respect to the memorials sent in by parties opposing the proposition of the Taunton Town Council to acquire the works of the Taunton Electric Lighting Company.

Mr. FLEETWOOD PRITCHARD appeared for the Corporation; Mr. AUSTIN, for the Taunton Gas Company; Mr. C. P. CLARKE, for the memorialists and others; and Mr. KITE attended on behalf of the Electric Light Company.

Mr. PRITCHARD opened the case by briefly sketching the history of Taunton, which he said was in every way a flourishing town. The population was now 18,000, as compared with 16,600 ten years ago, and 15,000 in 1872. Its area was 1245 acres; and its rateable value £76,000. There were 3476 burgesses. The town was progressive; and, having a water supply which, when completed, would be one of the best in the West of England, the inhabitants desired the electric light. This question of illumination was started, but not under statutory powers, in 1886; and in 1889 the works were removed to their present site. Soon after the Electric Light Company started, the Corporation decided to illuminate the streets with the light; and 29 lamps were put up in the first instance—there being now 36. Altogether, there were now 3½ miles of streets lighted by these lamps, or equal to 7 miles of frontage. This had naturally been more costly than the gas; the extra expense being about £500 a year. The price of gas had been raised since then from 3s. 9d. to 4s. per 1000 feet, subject to discount. During the past twelve months, the question of acquiring the undertaking of the Company had been considered by the Town Council. The subject first arose in December of last year. In that month the Lighting Committee considered the advisability of acquiring the undertakings of both the Gas and Electric Light Companies; and with the consent of the Council, they commenced negotiations. In January last they received an offer from the Electric Light Company to sell their works for £20,000, and one from the Gas Company for £74,000; the latter having certain conditions attached to it. The offer of the Gas Company was refused by the Council, because it was considered a higher price than the undertaking was worth; and the same decision was arrived at with respect to the offer of the Electric Light Company. The price of the latter then came down to £16,000. At this stage the matter was attracting the notice of the ratepayers;

and, in response to a requisition, a public meeting was called by the Mayor, and held on the 21st of March. There were present about 250 ratepayers, representing all interests. The Mayor opened the proceedings by stating that it was not a statutory meeting, and that a vote taken would have no effect whatever. Then Alderman Standfast proposed that it was not desirable to buy the electric light undertaking; and a discussion was carried on by both sides—one gentleman who was connected with the Company agreeing with the proposition, because the price to be given for the works was such a ridiculously small sum.

Mr. AUSTIN: What is the name of that gentleman?

Mr. PRITCHARD: Mr. Massingham. Continuing, he stated that there was some confusion in the counting of the votes. Both sides appeared about equal; but the Mayor declared the resolution carried by a small majority. He afterwards, however, noticed a number of hands on the platform voting against the motion. The Town Council evidently did not consider the resolution of any great weight, by what they did at their meeting on the following day. The Lighting Committee presented a report in which they went thoroughly into the matter; and the Council then empowered them to employ a skilled valuer. The Electric Light Company again reduced their offer. In the meantime, the Committee applied to the Board of Trade for the names of suitable gentlemen; and, as the result, Mr. Gisbert Kapp was employed, and his report was presented on the 3rd of May. He was called in to bless, and he cursed completely. The Committee were not satisfied with the report, because Taunton had always been considered a show town, and everyone was thoroughly pleased with the light. The Council still considered it desirable to purchase the electric light undertaking; and they turned their attention to the best means by which it could be done. On the 10th of May, the Committee presented a further report to the Council, asking them to authorize the Town Clerk to apply for a Provisional Order and for the Committee to continue negotiations with the Company to purchase on Mr. Kapp's valuation. The Council agreed to this by 13 votes to one. The Committee then recommended that they should apply to the Board of Trade for a Licence; and this was agreed to on July 14. The Council decided also that they would apply to the Local Government Board for sanction to borrow money for the purchase. The Council held the statutory meeting respecting the application for the Licence on the 26th of July; and then the resolution to do so was carried unanimously. In August it seemed to have come to the knowledge of Messrs. Laing, Wharton, and Down that Mr. Kapp's report had been presented; and, as that Syndicate supplied the electrical portion of the works, they were naturally not satisfied with the report. They accordingly instructed Dr. Fleming to make a further report. This was done. About that date a memorial was sent from ratepayers objecting to the proposed purchase. Since then, however, the Council had held three meetings in regard to the application to the Board for the Provisional Order, and there was only one member to vote against going on with it. In accordance with the resolution of the Council, the memorial for the Licence was sent. In answer to it, several objections were lodged; one stating that the loss to the ratepayers would be £1200 a year. He could not say where they obtained such a figure from; but the actual loss last year was £300. Dr. Fleming's report showed that there would be no loss, but eventually a profit. There was a second batch of ratepayers in opposition; and a third objection was made by the Gas Company. The town had some 10 miles of streets; and the cost of laying down mains for the continuous supply system recommended by Mr. Kapp would be very great. If only a few streets had this system, it would be scarcely fair to the rest. The streets were very well lighted now; and the Corporation wanted to extend it as much as they could.

Evidence was then given in support of the application.

Mr. *T. Meyler* (Town Clerk) spoke as to the proceedings at the public meeting at which the negative resolution was proposed. He counted 62 votes for the motion submitted; but he could not count the others owing to the confusion. He could not say there was any dissatisfaction shown to the Mayor's decision. The present Mayor (Mr. Alderman Fowler) was Chairman of the Electric Light Company. The light was started by Mr. Massingham, and then the Company purchased the concern. He did not know that Mr. Massingham had guaranteed a dividend for the first three years. He had heard that there was a dividend. The Council employed Mr. Kapp as their valuer; but they did not act upon his report, as the Company did not desire to break up their works for old iron. The contract for street lighting with the Electric Light Company was for seven years—from the year 1886 to 1893. They threatened to shut up their works if the Council did not apply for a Licence; but there was a bond by Mr. Massingham for the completion of the contract. There were about six members of the Council who were interested in the Company.

Mr. *W. M. Chapman* (ex-Mayor) said that he had large premises all lighted by electricity. He had lights equal to 160 lamps of 16-candle power; and he would be very sorry to lose the light. He, however, still retained his gas-fittings; and he had some oil-lamps. He was present as Mayor at the public meeting referred to, but did not count the votes himself, as he did not consider it of much importance one way or the other. He thought there were a few more for the resolution than against it; but when he stated as much, the Town Clerk pointed out that there were other hands on the platform. The object of the Corporation in purchasing the electric light undertaking was to continue the system in the streets; and they were also aware that a good many shopkeepers desired to retain the light.

Mr. *J. H. Smith* (Borough Surveyor) stated that he considered the present system of electric lighting much superior to the old one. When the light was installed, 80 gas-lamps were removed; and there were now 253 gas and 36 electric lamps. The cost of lighting the streets last year was £1334. The present cost of arc lamps was £22 10s. by contract; and the price was to be £25 per annum.

Mr. *J. Van Trump* (Chairman of the Lighting Committee) referred to the public meeting, and said he drew the attention of the Mayor to a large number of hands against the resolution, of which he took no notice. He heard several people afterwards remark that they did not know what they were voting upon. He used both gas and electricity, and was well satisfied with the latter, and would be sorry to lose it He considered the electric light one of the best advertisements Taunton had ever had. The extra cost of lighting the streets by electricity was largely caused by the additional lamps put up, owing to the growth of the town. He paid £22 a year for the electric light, and the Gas Company upwards of £200; so that he was not biassed when he said he thought the electric light was the better of the two.

Mr. *Norris* (Deputy Clerk to the Council) said the average total cost of lighting for the past six years was £1345 for gas and electricity; and £847 for the six previous years. The difference was £500 a year. A rate of 1d. in the pound produced about £250.

Mr. *Blakie* (Assistant-Electrician to the Company) said the length of cables was 7½ miles. There had been an increase in the number of lamps installed by 490 in November last year, against 917 this year. Mr. Massingham had an installation lately of 120 incandescent lamps. The whole apparatus had worked more efficiently under the increased load. The development of the works was retarded because there had been uncertainty as to the continued existence of the light.

Mr. *W. Potter* and Mr. *A. Steevens* having supported the application,

Dr. *Fleming* spoke to making the report referred to, which, in answer to Mr. AUSTIN, he said he had been requested by the Laing, Wharton, and Down Syndicate to prepare. His view was that the existing system was the most suitable for the present and future needs of the town. He was not aware that there was a "singular dearth of figures" in his report; he gave what he thought was required.

Mr. AUSTIN: And there was a singular number of hypotheses in it. Have you counted the number of "ifs"?

Witness replied that he had not. In answer to further questions, he said he did not agree with Mr. Kapp in all his statements. The cost per lamp of 50 street-lamps—1050 units for each arc lamp—would be £26. If the present plant could be loaded to its utmost capacity, the light could be produced at a profit.

This closed the case for the Corporation.

Mr. AUSTIN said he appeared on behalf of the Gas Company, who were rated at £1600; and he asked the Commissioners to say that it was not advisable that the Licence should be granted, on the ground that it would be a disastrous failure in the future as it had been in the past, and that the loss would have to be borne by the ratepayers instead of falling upon the shoulders of the Electric Light Company. He then briefly traced the history of the Company, bearing especially upon the part taken in connection with it by Mr. Massingham. Speaking of the dividends, he said that in the first three years they ranged from 5 to 6 per cent.; these, however, suddenly dropped in the fourth year—there being a deficit of £438 17s. 7d. The Company were at present insolvent—that was admitted by one of the Directors. It was for the Commissioners to say whether it was for the Corporation to take up the Company's works, and make a profit out of a loss. The position of affairs was very peculiar, as the members of the Council and the Aldermen were more or less interested in the Electric Light Company. It was only a laudable and natural desire on the part of these gentlemen to endeavour to get rid of this burden. The learned Counsel then dwelt at length upon the decision of the Council to have the opinion of an expert as to the value of the works, and referred to the appointment of Mr. Kapp, who made a report the *bona fides* of which there was no reason whatever for doubting. If that report was at all reliable, it was quite plain that the present system could not be worked except at a large outlay of further capital. This was a case in which the Corporation possessed a desire to save the money of their relations, or had taken a very sanguine view of the future working of the concern. In conclusion, he said the Gas Company would not oppose any other company of a like description; but what they complained of was the proposal to take over a concern which would be an appalling loss to the ratepayers and themselves.

Mr. *Gisbert Kapp* was then called. He said there were several reasons why the present system was not the best; the chief of them being (1) that it was not so convenient in its supply for consumers, and (2) that it was not economically workable over a small area. He had made an estimate of what the outlay would be for carrying out Dr. Fleming's plan. The annual expenses would amount to £3640 to keep the concern going; and the income would, if all the current generated by the machinery suggested by Dr. Fleming was paid for, be insufficient by about £1150.

Mr. CLARKE, on behalf of the ratepayers of the town, said that the question before the Commissioners was simply a financial one—whether or not this scheme could be made to pay. They acknowledged its superiority; but they contended it was too expensive. He urged that this burden should not be imposed upon them unless it could be shown it was a necessity, or that it could be made to pay.

Mr. *J. Standfast* asked leave to give evidence. He said he was a member of the Corporation, and the only one who had had the courage to hold up his hand. They had heard that the resolutions were passed unanimously; but this was not so, as he had always voted against them. He considered the whole thing had been "rushed."

Mr. PRITCHARD then shortly replied; saying he had to ask the Commissioners to report favourably to the Board of Trade, so that Taunton might not only have the best supply of water and the best drainage, but also the best system of lighting.

Sir T. BLOMEFIELD remarked that he must acknowledge that there were in Taunton the best lighted streets he had ever seen.

The inquiry then closed.

Extensions at the Conway Gas-Works.—The Conway Corporation have decided upon making various extensions and improvements at their gas-works; and they have placed the order for a new scrubber, washer, and other apparatus, with Messrs. R. Dempster and Sons, Limited, of Elland.

A New Water Scheme for Gainsborough.—At the meeting of the Gainsborough Local Board yesterday week, the Water Committee submitted a scheme for the supply of the town with water. The Committee are unanimously of opinion that the town can be supplied by an artesian well at considerably less cost than by any satisfactory river scheme. They recommend the construction of a well 250 feet deep, to be lined with cast-iron cylinders, and that efficient pumping machinery be placed therein; the estimated cost of these works being £8000.

THE STOURBRIDGE IMPROVEMENT COMMISSIONERS AND THE GAS-WORKS.

At a Private Meeting of the Stourbridge Improvement Commissioners last Saturday week, a resolution was passed by eight votes to three in favour of acquiring the local gas-works. The object of the meeting was set forth as follows in the notice convening it: "(1) To read and consider a report of the Gas Committee, recommending the Board (*a*) to give notice to the Stourbridge Gas Company of this Board's intention to buy the undertaking, rights, and powers of such Company; (*b*) to adopt and seal with the common seal (1) a contract between the trustees of the Star Life Assurance Society and this Board for the lending by that Society to this Board of the money to enable this Board to complete the purchase of such gas undertaking, and for other purposes; (2) a notice to the Gas Company of the intention of this Board to buy their undertaking, &c., which notice, when sealed and served, will constitute a binding agreement by this Board to buy, and the Gas Company to sell to this Board, the undertaking, &c., of the Gas Company; (*c*) to adopt a statutory declaration by the Clerk, and to instruct him to make the same. (3) If deemed expedient, to adopt the said recommendations and documents, and to order the sealing of such of the same documents as may be thought fit." According to a Birmingham contemporary, in the course of the meeting it was stated that the Company have a paid-up capital of £42,000, besides which £9250 has been raised by loans and debentures. The average profits of the last four years have been £4754; but the Commissioners have the right of purchasing them as at a date when the profits for the year were £3450. Assuming they could be acquired at a valuation or at as many years' purchase as the Leicester Corporation bought their works for—viz., 28½ years, this would be equivalent to £98,571 for the purchase of the Stourbridge works, *plus* £9250 *re* loans and debentures, or a total of £107,821. If thirty years' purchase had to be paid for the works, this, with the debentures, &c., would raise the amount to £116,200. Could the works be bought for a less number of years purchase, there would be a corresponding ratio of reduction in the total. The Star Insurance Company are willing, it appears, to advance a sum not exceeding £115,000 for the purchase of the works, and £5000 more for working capital, to the Commissioners, at 4 per cent., repayable by way of annuity in a term of forty years. They would, however, consent to the repayment in ten years of the balance of the loan which might be then outstanding, which would give the Commissioners the opportunity of reborrowing the outstanding sum at that time at a less rate of interest, if circumstances favoured the concern. The Star Life Office, in certain eventualities as to the amount of the purchase-money, reserve power to withdraw the offer of the loan; while the Commissioners on the other hand, after giving notice to the Gas Company to purchase the gas undertaking, have no power to break off the matter, but can be compelled to complete it. The repayment of principal and interest at 4 per cent. in forty years would amount, if £100,000 were borrowed, to £5052 per annum; if £110,000 were borrowed, to £5557; and if £120,000, to £6063. Mr. W. Jones moved that the Commissioners should give notice to the Stourbridge Gas Company to purchase the undertaking as from June 30, 1893; and this was seconded by Mr. E. Stringer. The mover of the resolution pointed out advantages which he anticipated would result from the acquisition of the works. Mr. Haskew deprecated the step proposed to be taken; and Mr. Pargeter urged the importance of an adjournment of the meeting to give time for due consideration of the report presented by the Gas Committee. The discussion ended in the resolution for the purchase of the works being carried, as already stated, by eight votes to three—six members not voting. Notice to the Gas Company of the intention to purchase the works was at once sealed; this notice, in the terms of the *agenda*, when sealed and served, constituting a binding agreement by the Board to buy, and the Company to sell, the works.

The question of the purchase of the gas-works has really been under consideration for the last two years; and it first received special prominence at the time the Commissioners decided to apply for a new Act of Parliament. They had already power to acquire the works under their old Act; but this could only be done in case certain of the outlying townships acted with them. Under the Act recently obtained. the Commissioners have power to purchase the works by themselves, as they now intend to do. It seems that one of the reasons which urged the Commissioners to take immediate steps in the matter was the proposal of the Directors to raise £5000 of additional share capital in January; this money being intended to be applied to the erection of a new gasholder and other works, which would to that extent enhance the purchase-money of the concern. Of the total annual make of gas, 31 million cubic feet are consumed in the borough, and 40 million feet in the outside district. The average profits of the Company have been for the last four years £4754; and it may be added that the profit of the last financial year was £5374. Half-yearly dividends respectively of £1596 and £1682 were declared; and £2099 was carried forward to the next account. The old stock carried dividends of 10 per cent.; and the later issues 7½ and 7 per cent. respectively. The Company have power to raise capital to the amount of £35,000 in addition to their present paid-up capital of £42,000.

A HUNDRED YEARS OF GAS LIGHTING.

Lecture by Mr. A. H. Bateman.

On Thursday, the 15th inst., a lecture on the progress of gas lighting during the past hundred years was delivered in the Public Hall, Belvedere, under the auspices of the Erith and Belvedere Natural History and Scientific Society, by Mr. A. H. Bateman, Past-President of the Society. Upon the platform and around the hall were arranged a number of models, diagrams, &c., which were brought into requisition and explained by the lecturer in the course of the evening.

Mr. Bateman divided his subject into four sections, dealing respectively with the history, chemistry, manufacture, and use of gas. In regard to the first, he described the circumstances under which William Murdoch discovered the illuminating value of the gas resulting from the carbonization of coal. Like most other discoveries, however, its practical application did not, he said, come till long afterwards. Having alluded to the work of Lavoisier, Priestley, and others, in connection with gas, the lecturer passed on to describe Murdoch's improvements in lighting by means of this illuminating agent, and also those of Winsor. Coming down to 1812, when the National Light and Heat Company was formed, and granted a Royal Charter, he traced the further progress of the invention, and the lighting of Westminster Bridge, St. Margaret's parish, the City of London, South London, and all the large provincial towns, during the following years. The subsequent history of gas lighting had, he said, been merely improvements of detail. Clay retorts had replaced iron ones; more pains were taken with purification; and exhausters were largely used. Most important of all the later discoveries was the value of the residual products; and the extraordinary series of coal-tar derivatives. Reference to these matters naturally led the lecturer on to the second section of his subject—viz., the chemistry of gas manufacture. He showed that this consists in taking to pieces, so to speak, the materials composing coal, and producing therefrom crude, and finally purified gas. Upon the complete evolution of the latter from the former depend, he said, the quality of the distributed article. But, even in its purified condition, it was still a complex fluid. The great thing was to get rid of the obnoxious properties of gas. Sulphuretted hydrogen was a specially unpleasant one; and therefore every effort was made to remove it before the gas left the works. Ammonia, on the other hand, was a very valuable constituent, the extraction of which was beneficial to the undertaking, as it was an appreciable source of income. With reference to the process of gas manufacture, which, the lecturer pointed out, must go on continuously, as the cessation of the supply of what had grown to be a common necessity would result in little less than a social cataclysm, the whole of the operations were explained by means of a small model. Commencing with the placing of the charge of coal in the retorts, he traced the gas through the condensers, washers, and purifiers, till it finally reached the holder—each appliance being described as he went on. Having conveyed the gas so far, Mr. Bateman gave his audience some information as to the arrangements for testing its quality, and also as to how to use it. He stated that, as a matter of fact, it was a most exceptional thing to find any gas sent out which was not of a perfectly satisfactory quality, and the complaints frequently heard about bad gas, were almost entirely due to the extraordinary indifference of the public as to the mode of consuming it. While people recognized the importance of having good grates in which to burn their coals, they were at the same time apparently satisfied with any sort of burners for their gas, and allowed them to be used until they were perfectly worthless before having them replaced. The result was that the good gas made by the companies yielded bad light, owing to the stupidity of most consumers. There was possibly some excuse to be found in the disappointment often experienced from the purchase of so-called wonderful burners sold by travelling salesmen, most of which turned out to be worth very little. It could not, however, be too strongly impressed upon the gas consumer that a shilling or two spent on a good burner would save 10s. in the course of a year. There were, he said, many excellent burners to be obtained, and he exhibited several specimens and explained their construction. Ordinary gas, as supplied to the general public of Great Britain, gave a light of about 1½ candles per cubic foot when consumed with a common burner; but with a better class of burner, this quantity of gas would give a light of 1⅞ or even 2 candles, or with governor burners from 2½ to 2¾ candles. It was therefore easy to see how a consumer could nearly double his light, if he only paid attention to his burners. For lighting on a larger scale, and with more expensive burners, a much higher illuminating power could be obtained. The Welsbach incandescent gas-light, while requiring some care in using, gave a bright light of 8 to 10 candle power per cubic foot of gas; and where regenerative lamps could be employed, upwards of 10 candles were obtainable from this quantity of gas. Mr. Bateman then referred to other uses for gas, such as for cooking, warming, and motive power, and invited the audience to further examine the samples and diagrams in the hall. In conclusion, he expressed his thanks to the several gentlemen who had assisted him, either by advice and information, or by the loan of models or drawings of appliances, in preparing his lecture.

Mr. Bateman's remarks were attentively listened to throughout; and at their close a cordial vote of thanks was passed to him for his very entertaining and instructive discourse. Before separating, the audience inspected the models, &c., to which reference had been made.

The Arbitration between the Richmond Gas Company and the Corporation.—Mr. Shiress Will, Q.C., the Umpire in the arbitration between the Richmond (Surrey) Gas Company and the Corporation of that borough respecting the charges for public lighting during the winter of 1890-91, when, owing to the severe frosts, the lighting was on several occasions defective, has given his award; and it is to the effect that the Town Council shall pay the Company the full amount claimed by them, and the costs of the arbitration. It will be remembered that the matter was recently before Justices Mathew and Bruce on a special case stated by the Umpire (see *ante*, p. 775).

Bilston Gas Company.—The report which the Directors of this Company will present to the shareholders at their meeting on the 2nd prox., states that the profits realized in the year ending Sept. 30 last are sufficient to provide the usual dividends. This result is attributable to the increased economy with which the manufacturing operations have been conducted under the supervision of the Secretary and Manager (Mr. J. S. Reeves), and the greater quantity of gas consumed. The additional gas sold shows an advance of 4½ per cent. for the year; yielding a revenue of £586. The financial statements accompanying the report show a balance of £4218 14s. 1d. on the profit and loss account. From this the Directors propose to pay dividends of 5s. and 3s. 6d. per share on the "A" and "B" shares respectively; making, with the interim dividends, 10s. and 7s. respectively for the year. The balance (£1803 14s. 1d.) will be carried forward.

THE METROPOLITAN WATER SUPPLY COMMISSION.

(*Lord* BALFOUR OF BURLEIGH, *Chairman*; *Sir* G. B. BRUCE, *Sir* A. GEIKIE, *Dr.* W. OGLE, *Professor* DEWAR, *Mr.* G. H. HILL, *and Mr.* J. MANSERGH, *Commissioners.*)

Twenty-sixth Day—Friday, Dec. 16.

On the resumption of the proceedings after the adjournment on the 17th ult. (see *ante*, p. 1007),

The CHAIRMAN said that on one or two occasions he had, by the instruction of the Commission, made statements as to the course of procedure they intended to adopt. It would be remembered that, early in the inquiry, they announced that they would take the general geological and other evidence of ascientific kind after that with regard to the present circumstances of the Water Companies, and the estimates of future population made by them. That one branch of the inquiry was nearly concluded before the Commission rose in July. The second class of evidence which he then indicated, in so far as it had been given by witnesses suggested to them, or by the Water Companies, the London County Council, the Hertford County Council, or by any persons interested, was subsequently taken early in the autumn; and, on the occasion of their last meeting, he promised, on behalf of the Commission, to make a further statement about procedure. Speaking generally, they had now concluded nearly all the evidence of witnesses whom they were likely to hear who had been suggested by others; but some small matters stood over. There was the evidence of Dr. Frankland with reference to some experiments which he had still in progress. Possibly, too, something more would come from Professor Lankester, as indicated in his evidence; and some representations had been made to them by one or two of the public authorities in the Metropolis, and the evidence of some witnesses on their behalf would hereafter have to be taken. For the first time that day they were to hear evidence from gentlemen who had been asked by the Commission to speak upon points within their knowledge. There would be in addition one or two further matters on which they should ask for assistance from witnesses who had not been actually suggested to them. They hoped that in one other set of sittings—he could not exactly say what would be the length of them, but not extending over many days—they would conclude the whole of the evidence that had been suggested to them, and all that they intended to ask for themselves. They thought that this set of sittings would probably be taken either at the end of January or very early in February, and that, so far as they could see at present, this would absolutely conclude the evidence they would seek for.

Mr. *W. Whitaker*, F.R.S., F.G.S., was then examined with reference to the area of Kent which lies to the east of the Kent Company's district. He stated, in reply to the CHAIRMAN, that, as a general rule, he thought the whole of the chalk was pervious, with certain variations locally and particularly. The chief exception was the lowest part of all the chalk, which was generally rather clayey, and therefore likely to impede the passage of water. That was at the very basis of the chalk, and had perhaps very little effect, because the area of outcrop was not very large. The chalk area extended over an enormous area south and south-east of England; and, speaking generally, it maintained a uniform character, though differing in thickness. There were local variations; in certain places the chalk was more jointed than usual, in some parts more finely bedded, and in others a little more clayey (a comparatively slight difference), and again in some parts the chalk was more compact. On the whole, the chalk was found to be more or less permeable throughout, except perhaps the lower part, which was the least permeable of all. Asked if he thought that this was on account of the structure of that part, or that it was simply because it was the lower that it was the less permeable, witness said at the top of the chalk there was a fairly permeable bed, the water in which was drawn out by the clayey bed beneath; but, as far as the whole of the lower chalk was concerned, he thought the position was the leading matter, and not strictly the geological character, because it was so where the lower chalk was favourably placed—that was to say, so placed that water could drain through it. This, as a rule, was on the face of the escarpment. It was rather a small case, perhaps, because the area was limited to where the escarpment was along a gentle slope, or where there was a double escarpment. Asked if he could give an explanation of the apparent fact that, under London, the water-level in the chalk was being depleted to the extent of about a foot, he said he thought that in London and other places, where the chalk was thickly overlaid with tertiary beds, and was not susceptible to any surface influence, the joints and fissures of the chalk were held together, and the chalk was kept in a compact state, and the flow of the water was very large. He believed it was the case that water did not flow into the chalk very readily under London. He was not sure that there was not another influence at work; London being in the hollow of a basin. It was a very gentle one, certainly; but the result of that would be to press together the fissures, more especially in the upper part of the chalk, and so militate against the flow of the water into it. Generally there was more or less communication downwards, so that the water in the lower chalk might easily be treated as a whole; but there seemed to be cases, even in the midst of the upper chalk, where, from the occurrence of more compact beds at certain depths, there was some division. In most districts he thought they could generalize when works were carried out on a large scale, which, of course, would be the case for any for the supply of London. The exception came in in smaller works. In some cases, as in that of the Brighton works, the fissures were very far apart—in one instance hundreds of feet apart; and there they had distinct flows along certain channels. In those channels there was plenty of water; the reason being apparently that water-bearing fissures of any size were fairly apart. But this did not apply over a large area. Another case occurred locally, where a boring was made in the chalk, and water was obtained at a certain level; but, on further works being carried out, no more water was procured. This showed, of course, that there was some horizontal stoppage between the two sets of water. He regarded these cases, as a whole, as exceptional; and he should say that in large works, such as would be carried out for the supply of London, it would have to extend far and wide laterally. As to whether or not, by taking the water from the chalk, they would be depleting the chalk at its higher or its lowest point, this was a matter on which he had the misfortune to differ from several of his friends. He held one opinion, and they another; and the correctness of neither, as far as he could see, could be proved. He thought they would lower the highest springs. He knew of cases where the lower springs, and of others where the higher ones, had been affected; but, unfortunately, in that case the works were close to them. He did not think the matter could be proved till tested. There were certain borings made in various districts in the chalk where it was bare, not in the tertiary area, where the borings had resulted in a flow of water at a somewhat higher level than the neighbouring streams, which proved that there must be some pressure behind the water at the higher level which was relieved at the borings. The actual boring made a clear communication for this water. He had seen one spring which had been "artificialized" to some slight extent. A length of pipe had been put down to this spring to keep it clear; and the result was that the water might be seen bubbling up above the level of the actual stream in which the spring was. This seemed to be evidence that there was very considerable pressure behind the water at the higher level. After a long time of boring, he should expect some effect, at all events on the higher springs. It might be many months, or even years. With regard to the water chiefly drawn from the chalk in northern Kent, he would like to emphasize this position—that in that particular area there could be no question of affecting the higher springs, for the very sufficient reason that practically there were no higher springs. The water over the greater part of that area did not form or contribute to streams. It simply ran into the sea or into tidal rivers; so that it did no good to anybody, and actually flowed out, one might say, to waste. This placed that area in a very different position to others.

The CHAIRMAN: But where it does flow out, it would be the higher people who would be the most likely to be affected, and require compensation.

Witness said the higher people would be only a few farmers; it would be a very small matter. In any scheme for taking this water on a more or less exhaustive scale, it would be essential that the rights of the present possessors should be safeguarded; and he saw no difficulty in doing this. The amount used in the district was in so small a proportion to that which could be yielded, that he thought no parliamentary committee would allow it to be done without taking care that the locality should have the first right over the water.

The CHAIRMAN: Would you define the extreme limits north, south, east, and west of the district to which this water in the northern part of Kent refers?

Witness: It refers incidentally to the Kent Company's district, as we were obliged to extend our view into that; but it alludes also to the limits specially marked out by the Commission eastward of the basin of the Darent, taking from that to the sea.

Mr. MANSERGH: Ramsgate to the North Foreland?

Witness: I should say not taking in the Isle of Thanet. Bounded on the west by the basin of the Darent, it extends across the basin of the River Medway to the Stour, and to the Dour, a little river—that is to say, the coast from near Folkestone to northwards of the Isle of Thanet.

The CHAIRMAN: To some extent it is outside the basin of the Thames, even in its most extended application.

Witness said it was when the Medway was passed. He would include the Medway as a part of the Thames, as being a comparatively small river, but, as a geologist, rather more because the Stour and all its tributaries undoubtedly once came out into the estuary of the Thames; and there was not much doubt that some of the water from the chalk eastward of the Stour tended to find its way towards the Thames now. With regard to the underground water, one could generally say, within some limits, in which direction it flowed. For instance, in the chalk and other permeable beds, the water slope would agree with the slope of the country. This was the general rule; and it held as a rule for this district, with certain exceptions.

Asked what were the factors which ought to be taken into consideration in deciding what amount of water could be obtained from that district, witness mentioned the area of chalk, whether bare or covered by various superficial deposits. By these he meant deposits not entirely pervious. Where they were pervious, as a rule they added to the supply. They would also have to consider first the chalk covered by tertiary beds, and certain spurs and projecting parts of the tertiary area that drained on to the chalk, the water from which certainly added to the water in the chalk; and next the amount of rainfall, and the proportion of it that percolated. The flow of the streams in this particular district was so small that it was hardly considerable. For instance, the chief stream—the Medway—might be altogether disregarded, as it was tidal through the whole extent of its passage through the chalk; so that all chalk water flowing into it was of no avail whatever to anyone, and every drop of it might be taken without in the least affecting the river. The Stour was not a purely chalk stream, and derived a large amount of its supply from various lower beds in the southern part of this valley—from greensand and gravel, &c. A very large area southwards of Kent contributed to the Stour from beds below the chalk; so that this stream was, to a certain extent, independent of the chalk water. There were springs coming out which he believed were fed by swallow-holes from tertiary beds; but that river was tidal a little below Canterbury. He very much doubted whether the quantity of water issuing from the chalk was the larger part of its flow. Then the Little Stour, its tributary, was a purely chalk stream, fairly insignificant; a great part of its course being very often dry. The other river—the Little Dour—was a short stream a few miles long, but fairly powerful during its course. This undoubtedly, he thought, might be damaged by excessive pumping, and would, of course, be a matter for compensation. The other streams were merely small ones along the margins, the water of which flowed into tidal water almost at once, and many small streams arising from springs.

Sir A. GEIKIE: There are one or two points I should like to get very definitely from you with reference to the connection between the supply of water from the chalk. First of all, will you tell us, as

clearly as you can, what is the nature of the joints in the chalk in the area of East Kent? Is there any one general direction?

Witness replied that there was through Kent one marked general direction of the joints, which ran more or less throughout the county—roughly speaking, north-west and south-east. This would be more or less parallel to the line of escarpment up to the Medway, when there was an alteration. The joints were fairly close together, as a rule. In East Kent it was a matter of a few feet, except in the case of the main holes, which were wider apart; but the consequence of the existence of those joints was to break up the chalk into a series of irregular polygonal masses. Sometimes the joints widened near the surface, and sometimes deeper down. In wells they often heard of fissures being struck at a considerable depth. In most instances—as at Brighton, Margate, Richmond, Lea Bridge, and Croydon—most of the water went along fissures. He did not think the chalk on the coast was more faulty than other areas; but there was a better opportunity for seeing the faults. Near London there were some very large chalk beds along the banks of the Thames; and, as a rule, there was very little fault in them. He thought the persistence of joints in one direction was marked more especially in East Kent than elsewhere. Along those divisional lines, his experience was that the water flowed very abundantly.

Sir A. GEIKIE pointed out that, in the memorandum which witness had prepared for the Commission, there was, in certain cases, a decided difference between the figures given by former observers and his own; and he asked if the circumstances under which the experiments were made were fairly comparable.

Witness said his examination was made last November. He believed it had been, on the whole, a dry season this year; and we were still several inches short of the proper rainfall. He had not gauged the springs. With regard to suggestions made to the Commission that artificial swallow-holes might be put down, and the water allowed to go into the chalk to be the more readily stored, he had seen this course taken some years ago for getting rid of drainage water in the fields; and it was also adopted along many roads in chalk counties. He expected, as a matter of fact, Nature had already done it in cases where there were fairly large streams flowing over the tertiaries.

In answer to Professor DEWAR, witness said that, for his own satisfaction, he had drawn up some calculations as to the quantity of water that could be drawn from the chalk; and he estimated that there was a total of 390 square miles of chalk with which they had to deal in Kent. One inch of rain a year was equal to 40,000 gallons of water a day per square mile; and on 390 square miles, it would, roughly speaking, be 15,000,000 gallons.

By Mr. MANSERGH: He thought a very large supplemental supply might be obtained for London by this means. He had not allowed for the increase in the population of those districts from which the water would be drawn, which were rural ones where there was no sign of growth; but if they doubled or trebled this population, it would be a very insignificant factor.

Mr. *W. Topley*, F.R.S., F.G.S., was next called. In compliance with the request of the Commission, he had made a special inquiry into the probable sources of water supply in the chalk areas of East Kent, with a great part of which he had made personal acquaintance in the course of his connection with the geological survey of that district; and he had since again visited the district in company with Mr. Whitaker and Mr. Easton. Replying to the CHAIRMAN, he remarked, at the outset, that he was quite convinced that pumping at a certain place would damage the district below—and they had proved that it did; but he could not see why it should damage the district above, nor had they any proof that it would. Questioned as to the effect of the operation upon the district above the point of pumping—whether a spot immediately above the place at which the water was taken, or a point higher up, would be the first and the most affected by the pumping—witness at once said the former would be. If affected at all, it might be to a considerable extent; but the damage done high above the pumping-station must be widely spread, and to a small extent affect one place.

Witness's attention was next directed to what he said concerning salt water in the chalk. Where, over a large area near the sea or a tidal river, wells and borings failed to produce a supply of fresh water, while in many cases they yielded salt water, there was clear evidence that the travel of inland chalk water was impeded, and that such areas were useless for water supply. This, the witness observed, was certainly the case along the coast of Essex and part of Suffolk. But he added that they were not justified in drawing the same conclusion from isolated instances, in which salt water had been found in wells or borings. Brackish water was also occasionally met with in the chalk. But at one of these places in the Grays district, the bore-holes were tubed either only just into the chalk, or else the tubes were perforated in the upper part, so that salt water might enter from the gravel. Those bore-holes were near the river; that farthest away being at a distance of only a quarter of a mile. The conclusion which witness drew from the statements he submitted was that a very large quantity of water was available from the chalk of East Kent; very little of this water being now used. The overflow passed directly into tidal waters, or into the sea. In addition to the water actually seen, there must, he added, be a large amount passing seawards underground; and, he observed, by driving long galleries, practically the whole of the upper waters in the chalk could be collected, while water in the lower beds could be obtained by wells and adits. A supplementary supply might be obtained from bore-holes carried down to the lower greensand.

Examined by Sir A. GEIKIE, witness said it was his opinion that the area of East Kent, east of the Darenth Valley, had a general formation which lent itself to a large water supply. There was a total area of chalk country of 467 square miles, of which 268 miles were bare. As to rainfall and percolation, the average rainfall over the area might, perhaps, be taken at 26 inches—possibly rather less over the lower ground, but it reached 30 inches on the higher areas of the chalk; and, in calculating the probable yield of chalk water from East Kent, he assumed a percolation of 8 inches over bare chalk, and of 6 inches over covered chalk. He took these figures because they were those used by him in his former evidence before the Commission. But he then stated his belief that they were too low; and fuller investigation, especially as regarded the area between Dover and St. Margaret's, greatly strengthened this belief. He had no doubt that the estimates of percolation now given might safely be increased 50 per cent. Attention was next directed to the witness's statement respecting subterranean water. He set forth that the underground water of the area spoken of was disposed in four ways—by springs at the foot of the chalk escarpment, these being fed only by the rain which fell near the escarpment; by streams, here called "Nailbournes," permanent in their lower parts, intermittent higher up the valleys, where they ran only in wet seasons; by springs on the low ground near the tertiary beds, where the plane of saturation intersected the surface, and by springs along the sea cliffs; and by a general underground travel of water seawards. This last way, the witness explained, was for the most part an inference. They knew, however, that the chalk beneath the sea-level was water-logged, and that the pressure of the inland water must be forcing the fresh water out; that springs issued along the foot of the chalk cliffs between high and low water-mark; and that water must be travelling beneath the "Nailbourne" valleys. Asked for details as to the amount of water discharged from these springs, witness observed that they were generally difficult to gauge. But Mr. Easton had recently succeeded in gauging three—one at the south-west corner of St. Margaret's Bay, yielding 2,750,000 gallons daily; another, 1,500,000 gallons; and a third, about 1,000,000 gallons. The three alone yielded upwards of 5,000,000 gallons; but the other springs, small and large, must give a large quantity in addition. Taken next to some tabulated details of the chalk areas of Kent, witness pointed out that the areas which comprised the basins of the Medway and the Swale, which drained entirely into the Thames estuary, contained 171 square miles of chalk—81 bare and 90 covered; and here there was a total average daily percolation of 47,500,000 gallons. This was the quantity which they assumed percolated at 8 inches for the bare, and 6 inches for the covered chalk. Asked how he arrived at this, witness replied that a percolation of 8 inches for the 81 square miles of bare chalk gave 25,900,000 gallons; and one of 6 inches for the 90 square miles of covered chalk gave 21,600,000 gallons—a total of 47,500,000 gallons. Proceeding, he pointed out that, taking in the wide area to the eastward—the Stour basin—they had a percolation of 57,000,000 gallons daily. The total estimated percolation of the Medway, Swale, and Stour was 104,500,000 gallons; and there was another and smaller area between the Stour and the Dour, where it would amount to 7,000,000 gallons. Altogether, this was 111,500,000 gallons. Asked what evidence he had that this amount would be yielded after a dry season, or a succession of dry seasons, witness said he thought that, as the percolation was under-estimated, it would in dry seasons come to something like what was stated.

Sir A. GEIKIE, noticing that the witness spoke of the area which yielded 7,000,000 gallons of water daily as a test district, by comparison with which they might form some idea of the great amount of water to be obtained from other chalk areas in East Kent, where the chalk water entered the sea or tidal streams, inquired if there was anything in the structure of the chalk in this area which he thought exceptional—which would lead to a larger supply of water than was commonly to be met with.

Witness said he did not think so.

Do you think the yield which you can gauge at those springs in the district between Dover and St. Margaret's might be taken as a fair sample of that of the whole chalk area in the Kent region of which we are speaking?—I do not see any reason to the contrary. Questioned as to the existing and probable future demands on the East Kent area, and as to whether there might be any difficulty in meeting these if a larger additional supply from Kent were called for, witness said he did not think there would be any difficulty. In the whole of the eastern area, including Dover, the quantity of water now taken was rather more than 6,000,000 gallons a day, and the private supplies, which were difficult to get at, might be put down at nearly 8,000,000 gallons; giving a total of 14,000,000 gallons. As to the method of obtaining a new supply from Kent, if it were determined to secure it, he believed that it would be most effectually done by a tunnel, or a series of tunnels, in the chalk. If one wanted to carry out the whole scheme straight away, he should begin tunnelling near the Medway. From that river to near Broughton-under-Blean, about 20 miles of tunnel might be driven, with pumping-stations at intervals. These works would drain the chalk of the Medway and the Swale. Then from the Stour to near Deal, about 14 miles of tunnel would drain the Stour basin. Six miles of tunnel from Deal to near Dover would collect the water flowing direct into the sea. A large proportion of the chalk water would be thus intercepted. Below this level no doubt there would be more water, for the abstraction of which wells with adits would be required. From the bottom of the main gallery, bore-holes should be put down into the deeper beds of the chalk; and in the western part of the area, these borings should be continued through the chalk and the gault to the lower greensand. As to salt water getting into wells or borings, his tunnels would steer clear of it altogether—it would be impossible for the salt water to get into them. With regard to the effect of pumping on the upper waters of the valleys, he repeated that he did not see why there should be any a long way off; and he had no proof of its being the case.

Sir A. GEIKIE reminded the witness that some clear evidence had been given to the Commission that this effect was produced; while other witnesses came to the very opposite conclusion.

Witness remarked that it was one of the most difficult questions which the Commission could have to decide.

In reply to Mr. MANSERGH, witness mentioned that he did not expect to get the whole of the 111,500,000 gallons of water by means only of the works he had described; but by these alone they would get a very considerable proportion of the whole. Below the level of the sea, they would have to sink shafts in the chalk.

Mr. MANSERGH: You cannot give me any idea of what proportion of the 111,500,000 gallons you would obtain by these works? Mr. Whitaker put it at about one-half.

Witness: I should think we should get more, because the proportion of percolation is greatly under-estimated.

The CHAIRMAN thanked Mr. Topley for his evidence, and said the

Commission were very much obliged to him for the great trouble he had taken in the matter.

Mr. *E. Easton* was also recalled. He had been requested to give the Commission information with reference to the capacity of the chalk strata in the watersheds of the Thames and the Lea for yielding supplies of water larger than those which were at present drawn therefrom, as to the permanence of any such yield of larger supplies, and as to the effect of pumping upon surface waters and upon adjacent wells; and he now submitted the results of a careful comparison of phenomena observed during his extensive experience in the construction of water-works for districts and towns deriving their water exclusively from the chalk. He was led to the conclusion that, though, of course, not identical, the chalk of the Thames and Lea basins bore a sufficient resemblance to that of the other chalk districts of England to justify the application of the facts and data relating to the water-producing capabilities of the latter to the former with the certainty of obtaining a very near approximation to the quantity of water which might be derived therefrom; and applying the facts in this way made it evident that the capacity of the chalk strata of the watersheds of the Thames and the Lea for yielding supplies of water larger than those now drawn therefrom must be very great. To the north and east of London there were plain evidences of a flow directly into the bed of the Thames; and the conclusion he came to was that there existed, in all the subsidiary chalk areas of the basins of the Thames and the Lea, a very large quantity of water which was passing away into the sea without being of the slightest benefit to anybody. As to the permanence of the supply, diagrams put in and facts stated proved to him that, as long as the rainfall of this part of England remained as it was, and had been for probably many centuries, there was no reason to doubt the recurrence of the phenomena which rendered the chalk the most trustworthy and certain source of supply. The question of the effect upon the surface waters and adjacent wells of pumping the extra quantity of water, was a more difficult one to answer; but, speaking generally, experience showed that the abstraction of water lower down did not affect the upper waters, whether flowing above ground or in subterranean channels; and he produced diagrams of actual working to illustrate this.

In reply to the CHAIRMAN, witness directed attention to the fact that between Gravesend and Northfleet, fresh water could be seen flowing out of the bare chalk in greater or less quantities at mean tide level. This was near the point of the excessive pumping at Northfleet, and almost in a line with the Gravesend Water-Works.

The CHAIRMAN: How do you account for that phenomenon there, while at Northfleet there is difficulty in getting water?

Witness: Simply that there, as almost in every case in the chalk, the water is running in well-defined channels or fissures; and, in this instance, Northfleet is drawing from a certain line of fissures, and these other fissures are independent of them.

You discredit, or do not attach importance to, the statement generally put forward, that by pumping a gradient, shaped like a cone, is formed in the surrounding water-level?—I do not believe in the cone.

Questioned further as to the water coming up through the bed of the Thames, witness gave it as his opinion that the water went into the river from both the north and the south. The behaviour of the levels or gradients in the chalk on both sides showed this.

The CHAIRMAN remarked at this stage of the proceedings that the Commission could not that day do the justice to witness's evidence which they should like; and he asked Mr. Easton if he could arrange to give a further attendance on a day to be hereafter fixed early in the New Year.

Mr. Easton having promised to reappear when called upon, the Commission adjourned *sine die*.

METROPOLIS WATER SUPPLY.

The Quality of the Water in November.

The returns furnished to the Registrar-General by the London Water Companies as to the water supply of the Metropolis during the past month, show that the average daily supply was 177,069,121 gallons, as compared with 173,045,298 gallons in the corresponding month of 1891. The number of services being 789,747, the rate was 224 gallons to each service. Of the entire bulk of water sent out, 90,023,223 gallons were drawn from the Thames, and 87,045,898 gallons from the Lea and other sources.

Reporting upon the quality of the supply, Dr. E. Frankland said: "Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies and by the Tottenham Local Board of Health was: Kent, 0·8; Tottenham, 1·6; Colne Valley, 2·2; East London (deep well), 2·7; New River, 3·4; East London (river supply), 4·1; Chelsea, 4·7; Lambeth, 5·6; Southwark, 5·7; Grand Junction, 5·8; and West Middlesex, 6·3. The unfiltered river waters gave the following numbers: New River cut, 4·8; the Lea at the East London Company's intake, 7; and the Thames at Hampton, 8·8. The Thames at Hampton was chemically, on Nov. 22, in a still worse condition than on Oct. 17; but bacterially it was considerably better. It was very turbid and brown; but it was, in every case except that of the Southwark, efficiently filtered before delivery. Contrasted with the raw river water, the supplies of the five Companies drawing from the Thames showed a chemical improvement varying from 29 per cent. (West Middlesex) to 47 per cent. (Chelsea); the bacterial improvement varying from 92·1 per cent. (Southwark) to 99·8 (Chelsea). The water taken from the gravel by the Southwark Company was, before filtration, 94·8 per cent. better than the water of the adjacent River Thames, and was bacterially of better quality than that issuing from two out of three of their filter-beds. The unfiltered water taken chiefly from the Lea by the New River Company was, on Nov. 23, both chemically and bacterially, in an unusually bad condition. Compared with the sample collected in October, it contained more than twice as much organic matter, and more than four times as many microbes. It was turbid and yellow, but was efficiently filtered before delivery; being at the same time improved chemically 36 per cent., and bacterially 99 per cent. The raw river water, taken from the Lea by the East London Company, was turbid and pale brown. Chemically, it was considerably better than the raw Thames water; but bacterially very much worse. It was efficiently filtered by the Company, and was further improved organically 42 per cent., and bacterially 99·9 per cent. The deep-well waters of the Kent Company and of the Tottenham Local Board of Health were of excellent quality for dietetic use; that of the Kent Company being especially distinguished for its very high degree of organic purity. The deep-well waters of the East London and Colne Valley Companies contained rather more organic matter than usual; but they were organically much better than any of the river-derived supplies. The Colne Valley Company's water, having been softened before delivery, was rendered suitable for washing. All these waters were clear and bright without filtration. Seen through a stratum 2 feet deep, the Kent, Colne Valley, and Tottenham waters were clear and colourless; the East London (deep well), clear and nearly colourless; the New River and East London (river supply), clear and pale yellow; the Southwark, very slightly turbid and yellow; and the remaining waters, clear and yellow. The bacteriological examination of the waters as they left the filters of the various Companies, by Dr. Koch's process of gelatine plate culture, gave the following results: One cubic centimetre of each water, collected on Nov. 18, 22, and 23, developed the following numbers of colonies of microbes: Chelsea, 4; East London, 5; Lambeth, 10; West Middlesex, 16; New River, 32; and Southwark (No. 1 filter), 148; Do. (No. 2 filter), 104; Do. (No. 3 filter), 30. Of the raw river waters, the Thames at Hampton developed 1868, the New River cut 184, and the Lea 7026 colonies of microbes per cubic centimetre.

Messrs. Crookes and Odling, in the course of their report to the Official Water Examiner for the Metropolis (General A. de Courcy Scott) on the quality of the water supplied by the London Water Companies during the past month, as shown by samples taken daily for analysis, state that, as pointed out, by anticipation, in their report for September, the lowness of the average proportion of organic matter present in the water for many months past could not, with the abundant fall of the leaf, and greater or less stagnation of fluviatile vegetation attendant on the coming on of winter, be expected to be much longer maintained. It was well maintained during the month of October; but in the case of the supplies furnished by each of the seven Companies during November, there was a noticeable increase in the proportion of organic matter present in the water, as indicated alike by the estimations of organic carbon, of oxygen required for oxidation, and of degree of colour tint. In the case of the Thames-derived water, for example, the mean amount of organic carbon in the supply for the month was found to be 0·204 part, and the maximum amount in any single sample examined 0·285 part in 100,000 parts of the water, as against a mean of 0·117 part, and a maximum of 0·155 part per 100,000 parts of water in the previous six months' supply; the mean increase, though relatively large, amounting, indeed, to an absolute addition of only 0·087 part of organic carbon in 100,000 parts of the water—corresponding as nearly as may be to an addition of about one-sixth of a grain of organic matter per gallon. The vegetable origin, moreover, of this small additional amount of organic matter is inferable from the fact that, while the mean ratio of carbon to nitrogen in the minute proportion of organic matter present in the supply during the previous six months was as 100 : 27·1, the mean ratio in the larger proportion present in the November supply was as 100 : 19·8; or, inferentially, the ratio of carbon to nitrogen in the excess of organic matter present in the November supply was as 100 : 9·4 only. Of the 182 samples of water examined during the past month, the entire number were found to be well filtered, clear, and bright. The flooded state of the rivers at the beginning of the month, consequent on the heavy rainfall during the last days of October, was altogether without noticeable effect on the character of the water supply. Throughout November there was no heavy rainfall; and the total fall was slightly below the average.

STOCKTON AND MIDDLESBROUGH WATER BOARD.

Half-Yearly Report—The Charge for Water for Manufacturing Purposes.

The report of the Stockton and Middlesbrough Water Board for the six months ending Aug. 13 last has been issued. It states that the capital expenditure for the half year has been £38,389, bringing up the total cost of the undertaking to £1,542,182. Of the capital expenditure during the half year, the principal items are as follows: On account of the Hury reservoir, £4,783; Blackton reservoir, £11,711; flood water channel, £1698; conduits Nos. 3 and 4 (gravitation main), £17,378; and extension of supply-mains, £1279. The sums received on capital account during the six months amount to £18,000; making the total £1,544,438—being £2256 more than the amount expended. The revenue account shows the income to have been £27,331; being a decrease of £3803, as compared with the preceding half year, and of £4451 as compared with the corresponding period of 1891—this decrease being accounted for by a diminution in the demand for water for manufacturing purposes. The expenditure on revenue account in the six months amounts to £8651; being an increase of £724, as compared with the preceding six months, and of £823, as compared with the half year ending Aug. 13, 1891. The balance carried to net revenue account is £18,680, as against £23,206 in the previous half year, and £24,054 in the corresponding half of 1891. The net revenue account is debited with several payments on account of alteration of the engines at Broken Scar and other matters, and is credited with the interest allowed by the bank. After being dealt with in this manner, there remains a balance of £29,818, including the sum of £11,568 brought forward from the preceding half year. A sum of £12,000 has been paid to the Corporations during the six months; leaving £17,818 to be carried forward, which has since been paid to the Corporations. The Board regret to have to report such a serious falling off in the net revenue; but they state that it is almost entirely owing to

the protracted strike in the colliery districts in the summer, which laid idle so many of the large manufactories in South Durham and Cleveland, from which a large proportion of the income is derived. The various works in hand continue to make satisfactory progress. The Hury reservoir was practically finished at the end of last year; and on several occasions since then, it has been filled. During the heavy floods of September and October, large quantities went over the overflow; so that the stability and tightness of the embankment may be considered to have been thoroughly tested. At present the reservoir is only used for the discharge of compensation water. Several interesting tables have been prepared by the General Manager (Mr. D. D. Wilson), dealing with the rate at which water is supplied for manufacturing purposes. The first table shows that since the year 1879 no less than 22,931,391,000 gallons of water, of which 7,990,105,000 gallons have been supplied to works outside the boroughs, have been sold at 3d. per 1000 gallons. In the second table, it is shown that the total cost on revenue account, exclusive of interest and redemption of borrowed capital, of supplying this quantity of water has been £101,262; while there has been received for the water £286,642, leaving a balance towards interest and redemption of £185,380. The cost, however, including all charges, averages 4·5580d. per 1000 gallons, giving a total cost of £438,371; while the sum received at 3d. per 1000 gallons only amounts to £286,642, or a deficit balance of £151,729. Between 1878 and 1892, the Stockton Corporation received out of revenue £4355 from the Board, but were called upon to subscribe to the capital to the extent of £23,889; the difference amounting to a rate of 2s. 8·62d. in the pound. During the same period Middlesbrough has received £4022, and paid to capital account £38,375, the loss to the rates being 3s. 6·66d. in the pound. Thornaby has received £1247, and paid £8928, or a loss to the rates of 3s. 8·95d. in the pound in the period named. The total loss to the constituent Corporations has been £65,562, which includes £55,296 redemption of borrowed capital. A further statement shows the amount expended on works in course of construction since Aug. 13, 1883, to be £505,778. The total borrowing powers of the Corporations under the Water Acts is set down at £2,360,746; and during the past two months, those bodies have subscribed £18,000 to the capital account of the Board.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Thursday.

The expiring year, so far as the working of the gas industry in Scotland is concerned, is not one which will stand out with prominence. There have been no events of importance—no transfers, no Acts of Parliament of consequence, no agitations among workmen, and no disasters. Times have been quiet, and work steady. In the working world, it will be remembered as the year when a slight amelioration began of the severe conditions which have for some years, owing to the high price of coal, made the industry an anxious one for all engaged in it. The increases in price which were common in the previous year, have in most instances given place to a slight reduction, with promise of more to follow. This has been accomplished by the fall in the price of coal, which is still going down. Were it not that the inevitable drop in residuals has also accompanied it, the prospect before the industry would be a very satisfactory one. As it is, there is every reason to be pleased. The demand for gas is growing. I cannot lay my hands on any report relating to a place of consequence which does not show a substantial increase upon two years ago. Edinburgh was down from the previous year's output by 16 million cubic feet; but that was accounted for by special circumstances—the output in 1890-91 having been abnormal, and the price in 1891-92 having been advanced to the high figure of 4s. 6d. It is, however, up upon 1890-91 by 128 million cubic feet. That the consumption is growing, no one who walks abroad at night need have any difficulty in perceiving. It is thrust upon his notice, in the increasing number of flaring shop-door lamps, and the improved lighting of shop windows, whether he cares or not. To those who know, it is also apparent in the extensions which are being executed upon many works. In Glasgow, the capacity of the Dawsholm works is being doubled, by the erection of a new retort-house and the construction of a monster gasholder. The Perth Gas Commission find it necessary to extend their purifying plant. In Dundee, large extensions have been made (as was mentioned in the JOURNAL last week). In Aberdeen, a re-arrangement of the works and enlargement of storeage capacity is being carried out at a cost of nearly £100,000. In Inverness, where the output is growing by between 3 and 4 million cubic feet a year, a new holder is in course of construction, besides many other extensions. The Paisley, Hamilton, and Alloa Corporations are also adding, or have added, to the efficiency of their undertakings. In fact, there is activity everywhere, which points to a healthy condition of things.

The event of the year in the working department has been the bringing out of Mr. W. Young's invention for the enrichment of coal gas with gas from oil, which has been already noticed in these columns. It will not, however, affect the working anywhere this year, except at Peebles; but when these "Notes" are being written at the close of 1893, there should be something to tell that will make pleasant reading.

During the year, the companion industry of oil manufacture has suffered a severe reverse; and, apart from its employment as a handmaid to gas manufacture, there is little hopeful in the outlook.

Electric lighting has, according to its friends, made great progress; but the casual observer would scarcely detect it. In Glasgow, early in the year, the Corporation acquired an existing installation; and they have been busy laying down new plant underground, to conform to the regulations of the Board of Trade. The Corporation of Dundee are also engaged in the fitting up of an installation. Both Corporations expected to be ready to earn revenue during the darkest period of this season; but neither of them are yet in a position to work their new plant—the delay being explained partly by the frosty weather at the end of last month. In Edinburgh, Paisley, and Aberdeen, although Provisional Orders empowering the providing of electric light have been obtained, nothing has as yet been done in the way of laying down plant for the purpose—the Corporations being content to wait as long as they can, to see what success attends electric lighting schemes in other places.

In the coal world, there has been a great fall in prices, the best cannel going down about 15s. per ton—from 35s. to 20s.; and the general average of coal for gas-works shows, in the contracts entered upon, a fall of from 6d. to several shillings per ton. The outlook, from the gas manager's point of view, is still encouraging. In common with other parts of the kingdom, extensive measures are being taken to increase the output of coal, which will have the effect of keeping down the price. Several large shafts are being made in Lanarkshire; and only the other day it was announced that a shaft which had been sunk in connection with the Earnoch Colliery, in Ayrshire, had reached a seam of splint coal 7½ feet thick, and surmounted by a 6-inch layer of cannel. The wages of the miners have been reduced during the year by from 15 to 20 per cent. If there is anything which may give rise to trouble in the coming year, it is the danger of the men, whenever opportunity offers, putting a stop to the output in an endeavour to get back what they have lost. At present, they are not sufficiently organized to enable them to attempt a combined movement; but a revival of trade would knit them together, and make it possible for them to harass their employers.

The failure of John Dobbie, Sons, and Co., of Leith and Elliot, and the closing of the Glasgow Alum and Ammonia Company's works, are the principal events of the year in the residuals market. Both were due to the heavy fall in the prices obtained for residuals after contracts were entered into.

In connection with water supply, the year has seen the great scheme for the extension of the Glasgow supply from Loch Katrine pushed considerably forward. The large reservoir at Craigmaddie, after having given great trouble in the procuring of a foundation for the embankment, is now within measurable distance of completion; and the contracts for the connecting-mains with the city have been let. Under authority obtained last session, the Corporation are about to supply water at high pressure for motive power. The Dundee Water Commissioners have, in the laying of a duplicate main from Lintrathen Loch to the city, overcome the risk of stoppage of the supply which arose from the unsatisfactory condition of the first main, laid in 1874. The Aberdeen Corporation are in Parliament with a scheme for the extension of their water supply, upon the lines of the existing arrangements. In Edinburgh, the Water Trustees have been for two or three years considering the advisability of obtaining an increase to the water supply; but they have not taken any formal step as yet, it being understood that, before going to Parliament, attempts are to be made to deal with waste.

The Dundee Gas Commissioners have, in reply to advertisements for gas coal, received a large number of offers. The contracts are to be for four months. It is found that the dearer coal has fallen in price from 2 to 12 per cent. since the last contracts were entered into in the summer; and there will thus be a considerable reduction in the rates to be paid.

The Stirling Town Council are again troubling themselves over the gas supply. They have often spoken of acquiring the undertaking of the local Gas Company; but they have always found something which discouraged them from going forward; and the Gas Company holds its ground. This time, a voyage has been started on a new tack. It is not the price of the undertaking which is in their mind, but the rate at which gas is sold. On the motion of a Mr. Lawson, the Council adopted a resolution embodying an instruction to their Clerk to write to the Gas Company, asking them to consider the expediency of giving their customers the benefit of the great fall in the price of coal which has occurred within the year. This is a very innocent motion; and the letter to the Gas Company, having a spice of impertinence in its assumption that the Directors were not likely to give the fullest benefit in their power to their customers, is harmless. Perhaps its purpose will be served if it shows the inhabitants that there is one in the Town Council who looks vigilantly after their interests.

The deputation from the Edinburgh Town Council, who were appointed to visit towns in England where electric lighting may be seen, have this week been about their work. They left on Monday night for London, and are to visit Bradford and other towns. Two electrical experts accompany them—Principal Grant Ogilvie, of the Heriot-Watt School, in Edinburgh, and Professor Stanfield, one of the teachers of engineering in the College. These are both sensible appointments to make. The function of the advisers is to direct the deputation as to what they are to look at, and to report upon what is seen. It is then the intention of the deputation to make a recommendation to the Council, and at a later stage to call in a consulting engineer of high standing. Principal Grant Ogilvie is not committed to any particular system of lighting; and in his selection the deputation have shown great wisdom. The city is fortunate in this matter, in the fact that Lord Provost Russell is himself a physicist, and is able to bring a mind already well prepared to the consideration of the subject.

Montrose is, in one respect at least, in a very favourable position with reference to its water supply—of the original cost of £20,000, only a little more than £1000 remains to be liquidated. The necessary result is a low water-rate; and it was probably that fact that led Mr. Mackie, at the Police Commission meeting on the 12th inst., to bring forward a proposal to lay a new water-main the entire length of the existing one. When the water supply was introduced, the Engineer recommended a 15-inch main; but the Police Commissioners laid a 12-inch one. Mr. Mackie's proposal was that a 24-inch main should be laid, the cost of which would be £9000, and would involve an increase of 4d. per pound on the rate. The benefit he looked for was increased pressure. In opposition to the proposal, it was stated that the present main delivers 41·51 gallons per head per day; and that, if pressure were wanted for the extinguishing of fires, it could be got by employing a steam fire-engine. The Commissioners rejected Mr. Mackie's proposal.

Everyone who has sailed down the Clyde from Glasgow is aware of the fearful extent to which pollution of the water exists. It is said that no one survives who is immersed in the water for a few minutes. The condition of the river has been a matter of anxiety to the Corporation since 1853; but probably few were aware of how serious the question

had become till recently, when the matter was referred to at a meeting of the Police Commission. Purification works are being constructed which will serve one-fifth of the city at the east-end; and Mr. Mason, at the meeting of the Commission, proposed a remit to the Committee which has charge of these works, to consider the whole question of the purification of the river. He estimated the outfall of sewage, all of which goes into the river, at 50 million gallons per day, or 9300 tons per hour. The Crown have interdicted the Clyde Navigation Trustees from depositing dredgings from the harbour in Loch Long, because they are impregnated with sewage; and he thought it was not likely that the Corporation would be allowed to make an outfall into the Firth either at Clock Point, 30 miles from Glasgow, or at Farland Point, which is upwards of 40 miles distant, and is opposite Arran. Irrigation was out of the question; the nature of the soil and the value of land making it impracticable. Filtration he regarded as a failure; and they had fallen back upon chemical treatment. They had put off the question in the past, in the hope that something would come to light whereby the river might be purified without cost to the ratepayers; but this could never be accomplished, and the Corporation must take up the question. Lord Provost Bell seconded Mr. Mason's proposition; and the remit was unanimously made. It is a pleasing feature of their public life that the Corporation are about to take steps for the removal of such a nuisance, before they are required to do so, either by the Crown or the County Councils of the neighbourhood.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Dec.* 22.

Sulphate of Ammonia.—There is very little demand from consumers; but this is nearly always the case at this time of the year. Dealers are still buying freely to cover their sales; but, in the absence of consumptive demand, ideas are being constantly reduced, and to-day generally not more than £10 is being offered. Makers are, however, still asking £10 1s. 3d. to £10 2s. 6d. Sulphate is by no means plentiful; and there is no reason why prices should not be maintained.

LONDON, *Dec.* 22.

Tar Products.—This market is undoubtedly firmer. Business of considerable magnitude has been done during the week; buyers evidently being tempted by the low prices prevailing, and the unlikelihood of them going lower. Carbolic acid and cresol are much improved. There appear to be no stocks anywhere; and buyers are becoming anxious about next year's requirements. Benzols are selling more freely; and prices are better. Anthracene is also firm; but no new business is reported. Values to-day are: Tar, 10s. to 11s. Pitch, 27s. to 30s. Benzols, 90's, 1s. 9d.; 50's, 1s. 5d. Toluol, 1s. 3d. Solvent naphtha, 1s. 1½d. Crude benzol naphtha, 30 per cent., 7½d. Creosote, 1½d. Creosote salts, 18s. Pressed naphthalene, 42s. 6d. Carbolic acid, 60's, 1s. 10d.; 70's, 2s.; crystals, 6½d. Cresol, 1s. 3d. Anthracene, 30 per cent., "A," 1s., nominal; "B," 9d., nominal.

Sulphate of Ammonia.—There is not the same activity in this market as there was at this time a month ago; buyers and middlemen apparently conspiring to hold off. Fortunately there are no important stocks; and makers are hopeful that the turn of the year will bring improved value. To-day's price is about £9 18s. 9d. to £10 1s. 3d., less 3½ per cent. Gas liquor is quoted at 6s. to 7s. per ton.

COAL TRADE REPORTS.

Lancashire Coal Trade.—The general condition of the coal trade of this district remains very much as reported of late. House fire qualities are moving away more freely prior to the holidays, but supplies are ample; and the commoner qualities, for iron making, steam, and general manufacturing purposes, continue a drug, with very low prices quoted. At the pit mouth, best Wigan Arley coal does not average more than 12s. to 12s. 6d.; Pemberton four-feet and second qualities of Arley, 10s. to 10s. 6d.; common round coals, 8s. 6d.; and the lower qualities of round coal, about 7s. per ton. The shipping demand also continues very quiet, with low prices ruling at the ports on the Mersey—steam coal being offered pretty freely at 8s. 3d. per ton, although better qualities are still quoted, in some cases, at 8s. 6d. to 8s. 9d. per ton. For engine classes of fuel, prices for the most part are fairly well maintained; and buyers find coal-owners altogether indisposed to give any concession in their quotations for ordinary supplies. At the pit mouth, best qualities of burgy range from 6s. 3d. to 6s. 9d.; best qualities of slack from 4s. 9d. to 5s. 3d.; medium sorts from 4s. to 4s. 6d.; with common, at about 3s. 6d. per ton.

Scotch Coal Trade.—The coal trade in Scotland is tapering off for the year. It is expected that a number of works will close early next week, and may not re-open till well into January. In most cases, a longer holiday than usual will be taken, which means less consumption of fuel. Scarcely any sales for home consumption are being effected, except for domestic purposes. Shipping orders are not to be procured at all; and now, when yearly orders are being completed, the exports are showing a decline. For the past week, they amounted to 134,652 tons—a decrease upon the preceding six days of 6458 tons, but an increase over the corresponding week of last year of 8113 tons. For the year to date, the total exports have been 7,425,871 tons—an increase of no less than 907,843 tons. Deliveries of gas coal, particularly of second and third qualities, are, of course, very large; but there is little market demand, and stocks of the best coal are accumulating. The prices quoted are: Main, 6s. 9d. to 7s.; ell, 7s. 9d. to 8s.; splint, 7s. 6d. to 7s. 9d.; and steam, 9s. per ton.

Roystone Water Supply.—The Barnsley Union Rural Sanitary Authority have received the sanction of the Local Government Board to the borrowing of £2000, for carrying out a scheme of water supply for Roystone.

Sales of Shares.—Twenty-two "A" £15 shares in the *Eton Gas Company* (earning a dividend of 10 per cent.) have recently been sold by auction at from £37 15s. to £38 10s.; and a number of "B" shares (on which a dividend of 7 per cent. is paid.) realized £27 5s. On the same occasion, 65 "O" shares in the *Windsor Gas Company* produced £41 to £43 apiece. Three "N" shares yielded £31 each; 15 "P" shares, £10 10s.; and 20 "N" shares of £20, upon which there has been a call of £8, fetched £11 5s.——At Leeds last Wednesday, Messrs. Hollis and Webb sold, among other stock and shares, £250 of "A" stock in *The Gaslight and Coke Company* for £222 per cent., and seven £2 10s. fully-paid shares in the *Churwell Gas Company* for £3 6s. each.——At Huddersfield last Tuesday, Messrs. Eddison and Taylor put up to public competition 82 ordinary and 42 new ordinary shares in the *Longwood Gas Company*; the former realizing £17 17s. 6d. each, and the latter £5 5s.

The Gas Difficulty at Accrington.—The Accrington Corporation are advised that the notice of increase in the price of gas given by the Gas and Water Company after the commencement of the quarter is bad. Readers of the JOURNAL will remember that the Town Council, at their last meeting, resolved to take Counsel's opinion as to the legality of the notice, and that several neighbouring Local Boards were prepared to abide by it. Counsel has now advised the Corporation that the notice will not stand; and what the result will be, it is not easy to say. Nearly all the gas consumers in the town have paid their bills for the quarter in question; and it will be a point for the Town Council to consider whether, in view of the fight which must take place in Parliament early next year, when the Company apply for additional powers, a contest in the Law Courts is expedient. The town's gas bill has not yet been paid, nor has the account sent in to the Church Local Board. There is a strong feeling in Accrington that the opinion given should be acted upon, and the matter fought out. An important development in the question is expected to take place. The Co-operative Society, who paid their account under protest when threatened with a cutting off of supply, have instructed their Solicitor to proceed against the Company for the recovery of the increase in price paid, if he should consider such a course advisable.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 1122.)

Issue.	Share	When ex-Dividend.	Dividend for last Half-year.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	14 Oct.	10½	Alliance & Dublin 10 p. c.	10	16—17	..	6 3 6
100,000	10	,,	7½	Do. 7 p. c.	10	11—12	+½	6 3 0
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	105—107	..	4 13 4
100,000	20	30 Nov.	8	Bahia, Limited	20	11—12	..	13 6 8
200,000	5	16 Nov.	7½	Bombay, Limited	5	5¾—6¼	..	6 0 0
40,000	5	,,	7½	Do. New	4	4—4½	..	6 13 4
380,000	Stck.	12 Aug.	12½	Brentford Consolidated	100	212—217	..	5 12 10
150,000	,,	,,	9½	Do. New	100	163—168	..	5 10 1
220,000	20	15 Sept.	11½	Brighton & Hove Original	20	40—42	..	5 9 6
888,500	Stck.	31 Aug.	5	Bristol.	100	103—106	..	4 14 4
320,000	20	29 Sept	11½	British.	20	41—43	..	5 6 11
50,000	10	31 Aug.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	,,	8½	Do. 7 p. c.	10	14½—15½	..	5 9 8
328,750	10	—	—	Buenos Ayres (New) Limited	10	7½—8½	..	—
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	99—102	..	5 17 8
150,000	20	12 Aug.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	14 Oct.	13	Commercial, Old Stock	100	232—237	..	5 9 9
165,000	,,	,,	10	Do. New do.	100	180—185	..	5 8 1
160,762	,,	15 Dec.	4½	Do. 4½ p. c. Deb. do.	100	120—125	..	3 12 10
800,000	Stck.	15 Dec	13	Continental Union, Limited	100	220—225	..	5 15 6
200,000	,,	,,	10	Do. 7 p. c. Pref	100	187—192	..	5 4 2
75,000	Stck.	15 Sept.	10	Crystal Palace District	100	185—190	..	5 5 3
486,090	10	28 July	10	European, Limited	10	19½—20½	..	4 17 7
354,060	10	,,	10	Do. Partly paid	7½	14—15	..	5 0 0
5,470,820	Stck.	12 Aug.	12	Gaslight & Coke, A, Ordinary	100	219—223	+1½	5 7 7
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	95—98	..	1 1 7
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	260—265	+1	3 15 6
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	116—121	..	4 2 7
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	166—171	..	4 7 8
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	161—166	..	4 4 3
463,000	,,	,,	10	Do. I, 10 p. c. Prf.	100	257—262	..	3 16 3
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	152—155	..	3 17 5
1,061,150	,,	15 Dec.	4	Do. 4 p. c. Deb. Stk.	100	117—120	..	3 6 8
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	122—125	..	3 12 10
908,000	,,	,,	6	Do. 6 p. c. do	100	163—168	..	3 11 5
3,800,000	Stck.	16 Nov.	12	Imperial Continental	100	222—225	..	5 6 8
75,000	5	30 Nov.	6	Malta & Mediterranean, Ltd.	5	4—4½	..	6 13 4
560,000	100	1 Oct.	5	Met. of Melbourne, 5 p. c. Deb.	100	107—109	+1	4 11 9
541,920	20	16 Nov.	5	Monte Video, Limited.	20	14⅜—15½	..	6 9 0
150,000	5	30 Nov.	10	Oriental, Limited	5	8—8½	..	5 17 8
60,000	5	29 Sept.	7	Ottoman, Limited	5	4—4½	..	7 7 4
166,870	10	—	2	Pará Limited.	10	2—2½	..	—
420,000	100	2 Nov.	6	People's Gas of Chicago— 1st Mtg. Bds..	100	103—107	..	5 12 1
500,000	100	1 Dec.	6	2nd Do.	100	100—105	..	5 14 3
150,000	10	—	10	San Paulo, Limited	10	8¾—9¼	..	—
500,000	Stck.	31 Aug.	15½	South Metropolitan, A Stock	100	287—292	..	5 6 2
1,350,000	,,	,,	12	Do. B do.	100	234—238	..	5 0 10
230,000	,,	,,	13	Do. C do.	100	243—248	..	5 4 10
725,000	,,	14 July	5	Do. 5 p. c. Deb. Stk.	100	140—144	..	3 9 6
60,000	Stck.	31 Aug.	11½	Tottenham & Edm'nton, "A"	100	225—230	..	5 0 9
				WATER COMPANIES.				
744,897	Stck.	1 July	10	Chelsea, Ordinary	100	248—253	..	3 19 0
1,720,252	Stck.	14 Oct.	8	East London, Ordinary	100	202—206	..	3 17 8
544,440	,,	1 July	4½	Do. 4½ p. c. Deb. Stk.	100	143—146	..	3 1 8
700,000	50	15 Dec.	8½	Grand Junction	50	104—108	..	3 18 8
708,000	Stck.	12 Aug.	11	Kent	100	275—280	..	3 18 7
1,043,800	100	1 July	9½	Lambeth, 10 p. c. max.	100	220—225	..	4 4 5
405,200	100	,,	7½	Do. 7½ p. c. max.	100	192—196	..	3 16 6
285,000	Stck.	29 Sept.	4	Do. 4 p. c. Deb. Stk.	100	123—128	..	3 2 6
500,000	100	12 Aug.	12½	New River, New Shares	100	325—330	..	3 13 6
1,000,000	Stck.	28 July	4	Do. 4 p. c. Deb. Stk	100	132—135	..	2 19 3
902,300	Stck.	15 Dec.	6½	S'thwk & V'xhall, 10p. c. max.	100	148—153	+½	4 4 11
126,500	100	,,	6½	Do. D 7½ p. c. do.	100	135—140	+ 1½	4 12 10
1,155,066	Stck.	15 Dec.	10	West Middlesex.	100	237—242	..	4 2 8

*Ex Div.

An Electric Lighting Offer for Singapore.—According to a paragraph which appeared recently in the *Singapore Free Press*, the Municipality have had an offer of having a portion of the town illuminated by the electric light for a month on the Thomson-Houston system, at what is regarded as the moderate cost of about $1000. It was thought by the above-named paper that the trial should certainly be made, whether or not it might be deemed advisable to adopt any general scheme for the electric lighting of the town, as a practical experiment, would go much further than any number of reports.

The Purchase of the Rhyl Gas-Works by the Local Authority.—On Monday last week, a special meeting of the Rhyl Improvement Commissioners was held to finish the arrangements in connection with the transfer of the gas-works from the Company. It was announced that the Board of the North and South Wales Bank had consented to advance the necessary money, in order that the Commissioners might complete the purchase on the 1st prox.; the negotiations for a loan (to which reference was recently made in these columns) having fallen through. It was afterwards decided to elect a Gas Committee of seven members; and Mr. J. Hepworth, of Carlisle, was appointed Consulting Engineer.

New Water Supply for Teignmouth.—The Teignmouth Local Board recently resolved to deal, in a very comprehensive manner, with the question of the water supply of the town. They have had a report on the subject from Mr. Bertram Nichols, in which he details a scheme for giving the town a constant supply of pure water, at a cost of about £20,000. He recommends that the best and most available supply is from the Becky Brook, the intake to be some distance below the Becky Falls, between 13 and 14 miles to the north-west of the town. The geological and other conditions are, he says, all favourable to a super-abundant supply of water; while the natural facilities presented by its physical conformation for the construction of a storeage reservoir and the working of a gravitation scheme, ensure the carrying out of the work at a fairly moderate outlay. The reservoir would have a capacity of 30 million gallons, equal to a full supply to the town for 100 days.

The Water-Works Purchase Question at Chatham.—The Mayor of Chatham, who is the leading spirit in the promotion of the scheme for the acquisition of the Brompton, Chatham, &c., Water-Works, has given some further information with respect to the financial proposals which will be embodied in the application to Parliament for the necessary powers. In the event of an Act of Parliament being granted, it is proposed to obtain the purchase-money on loan from a bank, and to give the present shareholders the option of taking up Corporation bonds in proportion to their shares in the undertaking; such bonds to be of £50 or £100 value as may be determined, and to be redeemable from year to year, so many in 5, 10, 15, and 20 years—the interest to be scaled according to the lives of the bonds. It is claimed that by this scheme the shareholders will receive larger percentages of interest than they do at present. It is remarkable, writes our local correspondent, to hear the arguments advanced in support of the scheme, and especially the chief point—the reduction of rates and of the price of water which is to result from the acquisition. The figures tabled almost indicate an absence of local rating through the profit on the undertaking; but, strangely enough—and yet, perhaps, not strange, since it would extinguish some of the glitter which the promoters have given to their projects—the figures supplied are based on the working expenses and dividends paid during the last two or three years; and in the parade of profits to be made, nothing whatever is said as to depreciation or eventualities which so often happen in connection with such undertakings. The main objection, however, which will weigh with the Parliamentary Committee before whom the Bill comes, will be the opposition of the Rochester Corporation, the members of which body consider that they have quite as much interest in the water-works as Brompton, Chatham, or Gillingham.

GWYNNE & BEALE'S PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams: "GWYNNEGRAM LONDON."

GWYNNE & CO., TELEPHONE No. 2698.

HYDRAULIC AND GAS ENGINEERS, BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

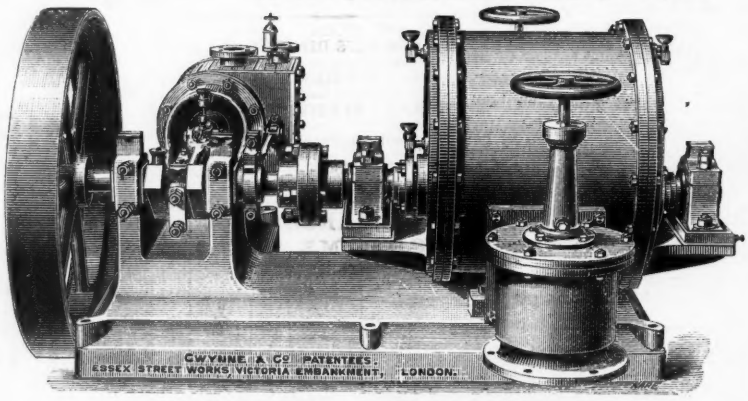
Late Essex Street Works, Victoria Embankment, London, W.C.

Thirty-three Medals at all the Great International Exhibitions have been awarded to GWYNNE & Co., for Gas Exhausters, &c.

They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality.

The result is that in every instance their work is giving the fullest satisfaction.

They have completed Exhausters to the extent of 30,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work, and can be referred to.



Engine and Exhauster Combined on One Bed-Plate.

GWYNNE & Co.'s Exhausters are constructed of large size to pass the required quantity of Gas at very slow speeds; the wear and tear being reduced to a Minimum.

Catalogues and Testimonials sent on Application.

Their Exhausters can be made, when desired, on their New Patent Principle, to pass Gas without the slightest oscillation or variation in pressure.

NO OTHER MAKER CAN DO THIS.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, STEAM-PUMPS for Tar, Liquor, or Water; PATENT SELF SEALING AND CLEANSING RETORT-LIDS AND MOUTHPIECES; CENTRIFUGAL PUMPS and PUMPING ENGINES specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH-SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

ANDREW STEPHENSON, Agent.
Please address all communications to the Company, as above.

ANDREW STEPHENSON, Agent for BRIN'S OXYGEN COMPANY, Limited, Westminster, S.W.
City Address: 182, Gresham House, Old Broad Street, LONDON, E.C.

VOLCANIC Fire Cement (Winkelmann's)
Fire Resistance 4500° Fahr.
ANDREW STEPHENSON, Sole Agent, 182, Gresham House, Old Broad Street, LONDON, E.C.

CANNEL COAL, ETC.

JOHN ROMANS & SON, EDINBURGH.
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 50, ST. ANDREW SQUARE, EDINBURGH, NEWTON GRANGE, NEAR DALKEITH, } SCOTLAND.

JAMES LAWRIE & CO. supply Best SCOTCH CANNEL COALS, Best FIRE-CLAY RETORTS, BRICKS, TILES, and LUMPS; BOILER SEATING BLOCKS, FLUE COVERS, and SILICA BRICKS for SPECIAL FURNACE WORK; COKE BARROWS, BOGIES, and SMALL WAGONS.
Postal Address: 1, WHITTINGTON AVENUE, E.C.
Telegram Address: "EIRWAL LONDON."

W. C. HOLMES & Co., Huddersfield, AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
*** See Advertisement p. I., centre of JOURNAL.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock, Oldham."

SADLER AND CO., LIMITED,
MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 70, Wellington Street, GLASGOW; 58, Fountain Street, MANCHESTER; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE, BAKER, & CO., direct Importers from Ireland. Sample and Price on application.
OXIDE PAINT, SULPHURIC ACID, & Chemicals.
120 and 121, NEWGATE STREET, LONDON, E.C.

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore.
Particulars and price, apply to Mr. T. L. ARCHER, Cathedral Chambers, Half Street, MANCHESTER.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

LIQUOR and Tar wanted.
BROTHERTON AND Co., Ammonia and Tar Distillers, LEEDS and WAKEFIELD.

FRIEDRICH LUX, Ludwigshafen am Rhein; and at No. 142, Great Portland Street, London, W.
LUX'S Gas Regulators for every consumption.
LUX'S single-stem Pressure-Gauges.
LUX'S Regulator for Gas-Engines.
LUX'S Gas-Balance.
LUX'S new Gas Regulator for Inverted Lamps and other Apparatus for Gas Lighting, &c.

MR. ARTHUR MEAD desires to announce that he is no longer connected with Messrs. Richmond & Co., Limited, of Warrington.
Present Address: "Eastbourne," Manor Road, LEYTON, E.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors, for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."

MESSRS. DEBENHAM, TEWSON, FARMER, and BRIDGEWATER'S MONTHLY LIST of Shops, Show-Rooms, Factories, and Waterside Premises, suitable for the Exhibition and Manufacture of Engineering and other Appliances, may be obtained, free of charge, at their Offices, 80, CHEAPSIDE, E.C.

MR. J. C. CHAPMAN, Fellow of the Chartered Institute of Patent Agents, advises on all matters connected with LETTERS PATENT FOR INVENTIONS and the PROTECTION OF TRADE MARKS, &c., at home and abroad. Preliminary Information and Handbook on application.
70, Chancery Lane, LONDON, W.C.

OXIDE OF IRON. Genuine Natural Bog ORE. QUALITY AND CONDITION GUARANTEED. Any quantity supplied at lowest rates.
D. M. NELSON AND SONS, 68, Bath Street, GLASGOW. Telegraphic Address: "Gas, Glasgow." Depôts throughout England and Scotland.

ANYONE calling on Gas Companies might add largely to his income by INTRODUCING the sale of CANNEL, which at this Season is much in request.
For prices apply, by letter, to No. 2169, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THE NEWLY-PATENTED BOWER REGENERATIVE GAS-LAMP.

VERY many thousands of Lamps under the old Patents sold, and four Gold Medals and other Prizes have been awarded to them in open competition; but the NEW LAMP *gives a much better light than the old one*, and is cheaper and more durable.
Particulars of GEORGE BOWER, St. Neots, HUNTS.

HONE'S Patent Grab and Elevator for digging and hoisting Coal, Ballast, Grain, &c., self-filling, self-discharging, saving 85 per cent. in labour, has proved a great success, and is now much in demand. AGENTS WANTED for the Provinces (only first-class men).
Apply to the MANAGER, Civil Engineering Department, Thames Iron-Works and Shipbuilding Company, Limited, BLACKWALL.

GAS MANAGER.

THE Denton and Haughton Local Board invite APPLICATIONS for the appointment of GAS MANAGER.
Salary, £200 per annum.
Applications, marked "Gas Manager," must be sent in, addressed to the Chairman, Gas Committee, Local Board Offices, Denton, near Manchester, on or before the 7th of January, 1893.
JOHN RICHARDS,
Clerk to the Board.
Dec. 21, 1892.

BOROUGH OF CARNARVON.

WANTED, a Practical Gas Manager, competent to superintend all Works in connection with a Gas-Works. Annual make, 20,000,000 cubic feet. Salary, £120 per annum.
Candidates to state Age, Experience, and References.
Applications to be sent in by Tuesday, Jan. 3, 1893, in sealed envelopes, endorsed "Gas Managership," and addressed to the Chairman of the Special Committee, Guildhall, Carnarvon.
R. O. WYNNE ROBERTS,
Borough Engineer and Surveyor.
Carnarvon, Dec. 17, 1892.

WANTED, Offers of Muriate of Ammonia (crude and refined), and all other Ammonia and Tar Products.
RINAU-KESSEL AND CO., Cologne, GERMANY.

FOR SALE—A perfectly new 20,000 cubic feet per hour EXHAUSTER, with Steam-Engine combined, including Hydraulic Gas Governor, Bye-Pass Valves, and Connections.
For further particulars, apply to Mr. T. G. MARSH, 41, Corporation Street, MANCHESTER.

WASHER-SCRUBBER.

FOR SALE—In perfect working order, almost equal to new, a Kirkham, Hulett, and Chandler's Patent "STANDARD" WASHER-SCRUBBER, capable of dealing with 500,000 cubic feet of Gas per day. Twelve-inch Connections. Only reason for disposing of same being too small. Could be loaded up on Rails entire, ready for work.
Further particulars may be obtained on application to
VINCENT HUGHES,
Engineer and Manager.
Gas-Works, Tipton, Dec. 6, 1892.

RETORTS AND FIRE-BRICKS.

THE Directors of the Rochester, Chat- ham, and Strood Gaslight Company are prepared to receive TENDERS for the supply of 1250 feet run of CLAY RETORTS, 20,000 FIRE-BRICKS, and 20 tons of CLAY, according to Specification and Form of Tender, which may be had on application, at their Office, 58, High Street, Rochester, where tenders must be delivered before Noon of Thursday, the 5th of January, 1893.
WILLIAM SYMS,
Secretary and Engineer.
Dec. 17, 1892.

HARTLEPOOL GAS AND WATER COMPANY.

TO IRONFOUNDERS, ETC.

THE Directors of the above Company are prepared to receive TENDERS for the several Works and Materials required in the construction and erection of a RETORT-HOUSE ROOF, 73 ft. 8 in. wide, and 126 ft. 10½ in. long; also a ROOF for a COAL-STORE, 14 ft. 4 in. wide, and 105 ft. 10½ in. long, both internal measurements.
Plans and Specification may be seen, or any further information obtained, on application to the Company's Engineer, Mr. Thomas Bower, who, if desired, will supply copies of the plans.
Tenders, on form prescribed, and sealed and endorsed "Tender for Retort-House Roofs," to be sent to Mr. Thomas Trewhitt, Secretary, Gas and Water Company, West Hartlepool, not later than Wednesday, the 11th day of January next.
The Directors do not bind themselves to accept the lowest or any tender.
By order of the Directors,
THOMAS TREWHITT,
Secretary.
Gas and Water Company's Offices,
West Hartlepool, December, 1892.

THE GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, so far as they relate to the Company's CAPITAL STOCKS, WILL BE CLOSED at Four o'clock p.m., on Tuesday, the 3rd day of January next, and will be re-opened immediately after the Half-Yearly General Meeting of the Company, to be held in the month of February next.
By order,
JOHN ORWELL PHILLIPS,
Secretary and General Manager.
Chief Office: Horseferry Road,
Westminster, S.W., Dec. 23, 1892.

APOLOGY (*Copy*).

Brixton, 17th December, 1892.

SIR,—Referring to the report contained in the *Eastbourne Chronicle* and other papers of expressions respecting you made by me at the General Meeting of the Eastbourne Gas Company, I beg to unconditionally withdraw those expressions, and to express my regret that I used the same.
Yours truly,
(Signed) THOMAS ARKCOLL.
Mr. John Hammond.

NOW READY.
GAS AND WATER CO.'S DIRECTORY, 1892.
Sixteenth Annual Issue, 5s.
GAS-WORKS STATISTICS, 1892.
Fourteenth Annual Issue, 3s. 6d.
WATER-WORKS STATISTICS, 1892.
Twelfth Annual Issue, 2s. 6d.
Handsomely Bound in One Vol., Price 10s.
LONDON: HAZELL, WATSON, & VINEY, Ltd.,
1, CREED LANE, E.C.

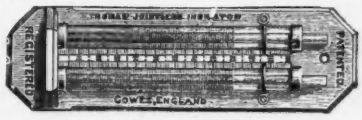
ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.
Prices and Analysis of all the Scotch Cannels on application

PRICE'S PATENT COKE & COAL BARROW

effecting a great saving of time labour, and expense.
For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee, 22, Alwyne Road, Canonbury, LONDON, N.
Prices are Reduced.

MEIKLEJOHN'S PATENT
Improved Slide-Valve Anti-Dip.
Is perfectly reliable in action, and requires no attention. Has all the advantages of the Dip and Anti-Dip combined.
Is cheap and easily fixed to any form of main.
Will be found the most efficient appliance of the kind yet introduced.
Further particulars and price from
C. MEIKLEJOHN,
GAS-WORKS, RUGBY.
(Late N. MEIKLEJOHN, Longwood.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.
QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.



THOMAS'S JOINTLESS GAS GAUGES.
COWES, I.W.
American Patent for Sale.

NIDDRIE CANNEL
A FIRST-CLASS CANNEL COAL,
Yielding a large volume of rich Gas, and fully 60 per cent. of first-class Coke.
FOR ANALYSIS, PRICE, AND ALL OTHER PARTICULARS, APPLY TO
The Niddrie & Benhar Coal Co., Ltd.,
4, York Buildings, Queen Street,
EDINBURGH.
Telegrams: "BENHAR, Edinburgh."

THOMAS ILLINGWORTH,
NORTH DEAN CHEMICAL WORKS,
Near HALIFAX,
MANUFACTURER OF SULPHURIC ACID
OF EXTRA QUALITY FOR MAKING
WHITE SULPHATE OF AMMONIA.
TAR, LIQUOR, AND SPENT OXIDE
Purchased for Cash against Delivery.

UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

CAST-IRON PIPES
FOR GAS AND WATER.
Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.
VALVES
FOR GAS, WATER, AND STEAM.
TELEGRAMS: "PIPES GLASGOW."
WM. MACLEOD & CO.,
56, ROBERTSON STREET, GLASGOW.

THE SILICA FIRE-BRICK COMPANY,
OUGHTIBRIDGE, near SHEFFIELD
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."
These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

HOLMSIDE GAS COALS.
(Wrought out of Holmside and South Moor Collieries.)

PRESENT production over 3200 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16½ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves about 70 per cent. of excellent Coke. To show the progress of HOLMSIDE COALS, it may be mentioned that the quantity carbonized by the London Gas Companies in 1885 was about 200,000 tons; whereas the present consumption of HOLMSIDE COALS in London alone is at the rate of over

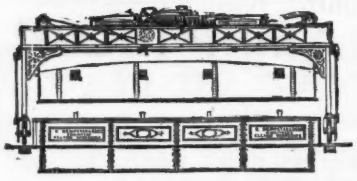
400,000 Tons per Annum.

Full particulars on application to

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-ON-TYNE.

ALEXANDER RUSSELL & CO.,
Cannel and Gas Coal Merchants,
53, WATERLOO STREET,
GLASGOW.

DEMPSTERS'



PURIFIERS (MACHINED JOINTS)

PURIFIERS.

ELLAND.

TAR.

GAS COMPANIES should not sell at the present low price, but use it for heating their Boilers or Retort-Settings with

WALKER'S
PATENT
SPRAY BURNER.

Its Heating Value is Twice as Great as Coke.

APPLY TO
C. & W. WALKER,
MIDLAND IRON-WORKS,
DONNINGTON, near NEWPORT,
SALOP.

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

THOMAS TURTON AND SONS, LIMITED,

Sheaf & Spring Works,
SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
London Office:
90, CANNON STREET, E.C.

JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.

Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE
BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

For Prices and complete Analysis, apply to
YOUNG, DANCE, & CO.,
COAL OWNERS, NEWCASTLE-ON-TYNE.
Or E. FOSTER & CO., 21, John St., Adelphi, LONDON, W.C.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.,
Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Danish Gas Company of London, Ipswich Gaslight Company, Devonport Gas Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the

HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
FITTER.

AUG. KLÖNNE,
DORTMUND (GERMANY).

REGENERATIVE FURNACES.

Unsurpassed in Efficiency, Economy, Durability, and Easy Working.

JAMES WHITE & CO., LTD.,
WIDNES, LANCASHIRE,
Manufacturers of Special
FIRE-BRICKS, FIRE-CLAY, & FURNACE CEMENT.

FOR GAS FURNACES our GANNISTER and SILICA FIRE-BRICKS are acknowledged to be the best and most durable in the Market.

GANNISTER and SILICA FIRE-CLAY guaranteed the Purest Quality.

FURNACE CEMENT specially made for repairing Furnaces and stopping Cracks.

ANALYSIS AND REFERENCES ON APPLICATION.

T. B. KITTEL, SHEFFIELD.
CONTRACTS FOR SUPPLIES OF ANY OF THE PRINCIPAL
ENGLISH & SCOTCH CANNELS.
REAL SILKSTONE GAS COAL
ANALYSIS AND PRICES ON APPLICATION.
T. B. KITTEL, SHEFFIELD.

Price: Morocco, Gilt, 18s.; Cloth, 15s.; Delivered Free.
THE FIFTH EDITION OF THE
HANDBOOK
FOR
Gas Engineers and Managers,
By THOMAS NEWBIGGING, M.Inst.C.E.
LONDON:
WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

HYDRATED OXIDE OF IRON
FOR GAS PURIFICATION.
Two to three times as rich in Hydrate as Bog Ore.
STRONG ACTION ON SULPHURETTED HYDROGEN.
We have for sale Hydrate of Iron containing 77 per cent. of Ferric Oxide and 17 per cent. of Water. Directions given for mixing for Purifiers.
LESS THAN HALF THE PRICE OF BOG ORE.
APPLY TO—
READ HOLLIDAY & SONS, LTD., HUDDERSFIELD.

The "POPULAR."

No. 5 . . 45s.
No. 10 . . 63s.

The FULLFORD
REGENERATIVE GAS-LAMP.
SIMPLEST
MOST ECONOMICAL
MOST RELIABLE
} IN THE MARKET.
IN THREE SIZES, 60, 120, AND 180 CANDLE POWER.
BEST IN THE WORLD FOR OUTSIDE SHOP LIGHTING.
Sole Licensees and Manufacturers,
The LAMP MANUFACTURING Co., Ld.,
12 & 14, LEONARD STREET,
CITY ROAD, LONDON, E.C.
ILLUSTRATED PRICE LIST FREE ON APPLICATION.

GAS COAL.
BEST
REAL OLD SILKSTONE GAS COAL,
Address THE STRAFFORD COLLIERIES COMPANY,
Near BARNSLEY, SOUTH YORKSHIRE.

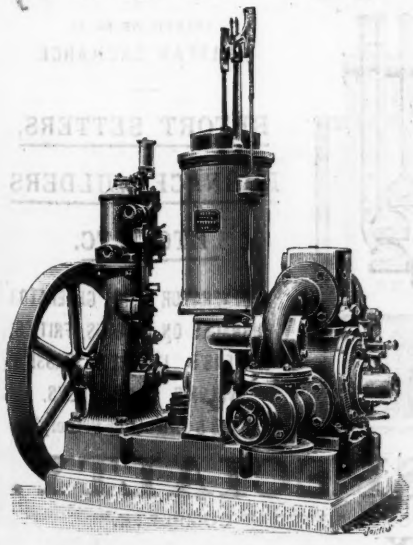
Wrought-Iron

And Fittings and Accessories.

LAMBERT BROS., WALSALL,
MANUFACTURERS OF
WROUGHT-IRON TUBES & FITTINGS for GAS, WATER, & STEAM,
BRASS GAS-FITTINGS, GAS-VALVES, STEAM & WATER VALVES, TOOLS, &c., AND OF
WARNER'S PATENT MARKET GAS STAND-PIPE.
LONDON: LAMBETH BRASS & IRON CO., Short Street, LAMBETH.

JOHN BROWN & CO., LTD., SHEFFIELD,
Proprietors of
ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.
ALDWARKE MAIN GAS COAL
Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
Telegrams: "ATLAS SHEFFIELD."

G. J. EVESON,
GAS COAL AND CANNEL CONTRACTOR,
PATENTEE OF
A Special Compound for the cure of Stopped Ascension-Pipes. A couple of charges will clear a stopped Pipe, and an occasional charge keeps them clean; also increases the Make per ton and the Illuminating Power.
Prices and Particulars on Application. HEAD OFFICES: CORPORATION STREET, BIRMINGHAM. TELEGRAPHIC ADDRESS: "EVESON, BIRMINGHAM."
THE WATERBLEAN COLOR AND MINING COMPANY, MILLOM, CUMBERLAND.
TELEGRAPHIC ADDRESS: "WATERBLEAN MINES, MILLOM." PORTERAGE, 1s. 6d.
VENETIAN AND OXIDE REDS for the Manufacture of ANTI-CORROSIVE PAINTS.
Specially adapted for the Ironwork of Gas-Works and wherever subject to exposure.
G. J. EVESON, Proprietor, Corporation Street, Birmingham.
ORDERS TO BIRMINGHAM, OR DIRECT TO THE MINES.



WALLER'S PATENT COMBINED GAS ENGINE AND EXHAUSTER
WITH
Disc-Valves, Automatic Bye-Pass Valve, Throttle-Valve, and Regulator,
COMPLETE ON ONE BASE PLATE.
Designed chiefly for sizes from 500 to 15,000 feet per hour.
CAN BE SEEN IN ACTION AT ADDRESS BELOW.
EXHAUSTERS OF ANY SIZE
COMBINED WITH GAS-ENGINES (now made to vary in speed).
ENGINES & EXHAUSTERS RUN AT DIFFERENT SPEEDS.
Waller's Washer-Scrubber with Wood Clusters.
ELEVATING AND CONVEYING MACHINERY FOR COAL, COKE, &c.
G. WALLER & CO.,
58, PARK STREET, SOUTHWARK (SURREY SIDE OF SOUTHWARK BRIDGE).

ALEX. C. HUMPHREYS, M.E.
General Superintendent & Chief Engineer,
The United Gas Improvement Company, U.S.A.

A. G. GLASGOW, M.E.,
Late General Inspector,
The United Gas Improvement Company, U.S.A.

HUMPHREYS & GLASGOW,

Contracting Engineers for Water Gas Plant,
9, Victoria Street, London, S.W.

JOHN HALL & CO.,

STOURBRIDGE,

MANUFACTURERS OF FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

RETORTS CAREFULLY PACKED FOR SHIPMENT.

A STOCK OF DIFFERENT SHAPES ON HAND.

GAS AND WATER PIPES

AND

CASTINGS OF EVERY DESCRIPTION.

MANUFACTURED BY THE

CLAY CROSS COMPANY,

CHESTERFIELD.

TRADE	TELEGRAMS:	LONDON AGENTS:
C X O	"JACKSON"	BECK & Co.,
MARK.	CLAY CROSS.	130, GT. SUFFOLK ST., S.E.

GODDARD, MASSEY, & WARNER'S

IMPROVED

Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

FOR REFERENCES, PARTICULARS, TESTIMONIALS, AND PRICE APPLY TO

GODDARD, MASSEY, & WARNER,

ENGINEERS,

NOTTINGHAM.

The Apparatus has been supplied to the following Firms—

BURT BOULTON, & HAYWOOD, SILVERTOWN, and ELING.
CHANCE BROTHERS, OLDBURY (Four Apparatus).
RUNCORN SOAP & ALKALI CO., Limited, RUNCORN.
NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited, SHADWELL.
WM. BUTLER & CO., BRISTOL.
KEMPSON & CO., Pye Bridge.

And to the following Gas Companies and Corporations—

ILKESTON.	BURY.	CHORLEY.
WIDNES.	BRIGHOUSE.	WHITEHAVEN.
HALIFAX.	MARKET HARBRO'.	CHESTER.
ALTRINCHAM.	PRESCOT.	SOUTH SHIELDS.
DENTON.	SOWERBY BRIDGE.	LEEK.
ST. ALBANS.	LEICESTER.	IPSWICH.
DUKINFIELD.	DARWEN.	BOURNEMOUTH.
NORTHWICH.	NELSON.	SALFORD.
HUDDERSFIELD.	ORMSKIRK.	LUTON.
		HAMPTON COURT.

JONAS DRAKE & SON,

TELEGRAPHIC ADDRESS:
"DRAKESON, HALIFAX."

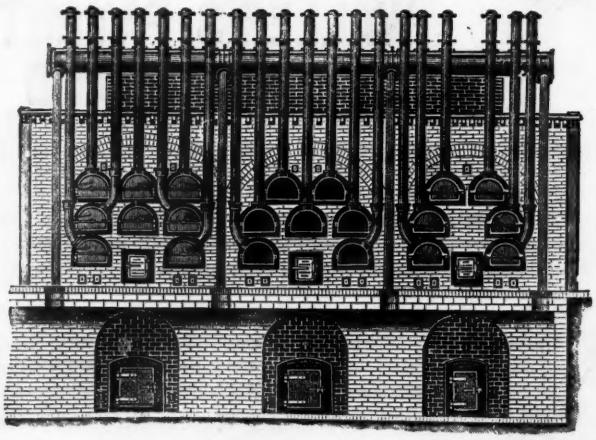
TELEPHONE No. 43.
HALIFAX EXCHANGE.

GAS ENGINEERS,

CONTRACTORS,

IRONFOUNDERS,

BUILDERS AND ERECTORS OF EVERY DESCRIPTION OF OVENS, BENCHES, KILNS, FURNACES, &c.



RETORT SETTERS,

FURNACE BUILDERS

ETC., ETC.

REGENERATOR AND GENERATOR FURNACES ON DRAKE'S, FRITH'S, SIEMENS'S, KLONNE'S, HASSE'S VALON'S, SOMERVILLE'S, PONSARD'S and other Principles.

INCLINED RETORTS

GASEOUS FIRING A SPECIALTY.

RETORT SETTING IN ALL ITS PRINCIPLES AND BRANCHES. BENCHES FITTED UP COMPLETE.

OVENDEN, HALIFAX.

DRAWINGS SPECIFICATIONS, AND ALL OTHER PARTICULARS ON APPLICATION.

JOSEPH CLIFF & SONS,

INCORPORATED IN
THE LEEDS FIRE-CLAY COMPANY, Ltd.,

WORTLEY, LEEDS.

LONDON Offices & Depôts:
Baltic Wharf, Waterloo Bridge.

WHARVES NOS. 2 & 4, INSIDE G.N. GOODS YARD, KING'S CROSS, N.

LIVERPOOL:
16, Lightbody Street.

LEEDS:
Queen Street.

MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

ESTABLISHED MORE THAN A QUARTER OF A CENTURY.

WORKS
HUNSLET.
LEEDS

LONDON OFFICE:
60, QUEEN VICTORIA STREET
E.C.

CLAYTON SON & CO. LTD.

MAKE A

SPECIALTY OF

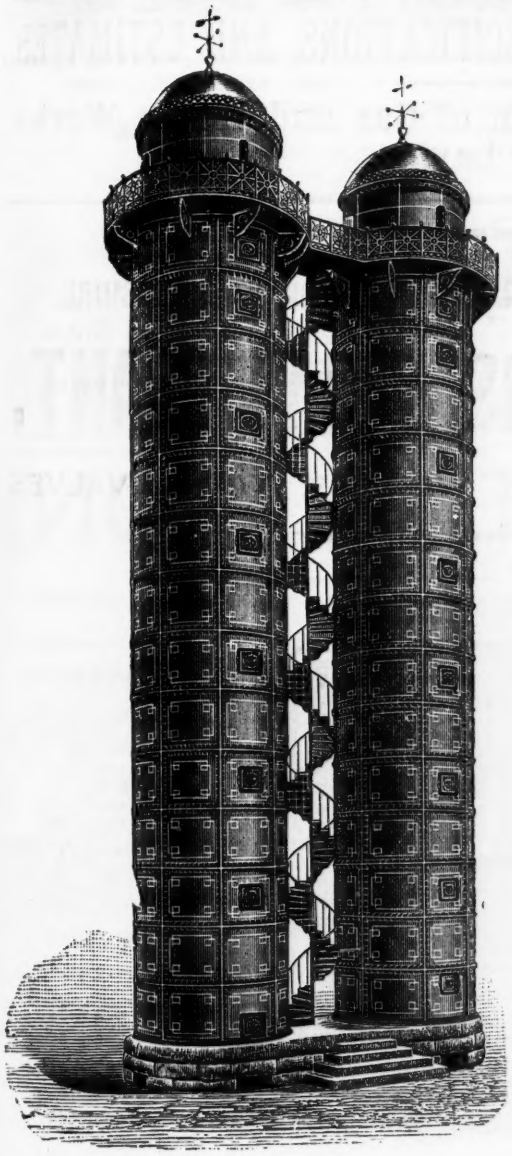
GASHOLDERS

AND MAKERS OF

REGd. TELEGRAPHIC ADDRESS: "GAS LEEDS"

GAS PLANT OF EVERY DESCRIPTION.

R. & J. DEMPSTER,



ENGINEERS, IRONFOUNDERS,

AND CONTRACTORS,

Gas-Plant Works, Newton Heath, MANCHESTER.

TOWER SCRUBBERS WITH PLANED JOINTS OF HANDSOME DESIGN.

Messrs. R. & J. D. wish to specially direct the attention of Gas Managers to the larger quantity of Ammoniacal Liquor or Sulphate **made** by their Scrubbers than by any of the numerous Rotary and other Machines now upon the market. From 28 lbs. to 34 lbs. of Sulphate are produced (per ton of coal carbonized) by their Scrubbers; whereas 20 lbs. to 22 lbs. is as much as can be got by the Machines. Gas Managers with low yields of Sulphate should not rest satisfied (because Ammonia does not show on test papers) until they are getting all the Ammonia it is possible to make. It should be remembered that each gallon of liquor, or 1 lb. of Sulphate, is worth about 1d.; thus, when every ton of coal carbonized is multiplied by 6d., 8d., 10d., or 1s., from increased yield of Sulphate on the quantity of coals used per annum a very large extra profit is made. Irrespective of the profit made from the increased yield of Ammonia, these Scrubbers utilize the Ammonia as a purifying agent, and very considerably reduce the amount of work to be done in the purifiers.

London Offices:

181, GRESHAM HOUSE, OLD BROAD ST., E.C.

ESTABLISHED 1825.

GAS TUBES

MANUFACTURERS OF EVERY DESCRIPTION OF

IRON OR STEEL LAP-WELDED OR BUTT-WELDED TUBES

FOR ANY PURPOSE.

FOR **RETORT-SETTINGS & FURNACE WORK**

OF EVERY DESCRIPTION,

Messrs. J. & H. ROBUS,

20, BUCKLERSBURY, LONDON, E.C.,

ARE PREPARED TO SUBMIT PLANS, SPECIFICATIONS, AND ESTIMATES.

Contractors for the complete Erection of Gas and Water Works, including Main Laying.

THE HORSELEY CO., LTD., TIPTON, STAFFORDSHIRE,

MAKERS OF **GAS HOLDERS & GAS PLANT,**

PURIFIERS, SCRUBBERS, CONDENSERS, WASHERS, TANKS, VALVES

PIPES, LAMP PILLARS. RETORT-FITTINGS, ETC.

ALSO ALL KINDS OF

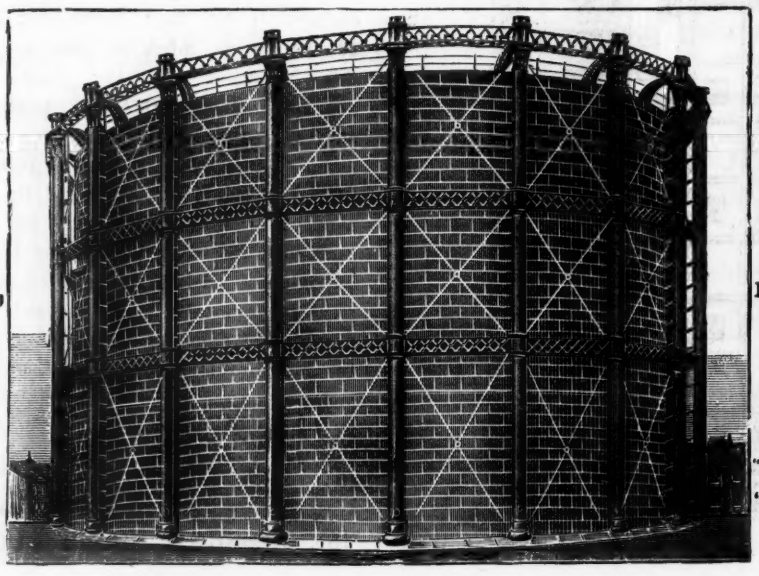
STRUCTURAL IRON

AND STEEL WORK.

BRIDGES,

ROOFS,

PIERS, ETC.



WORKS & HEAD OFFICE:
TIPTON,
STAFFORDSHIRE

LONDON OFFICE:
11, VICTORIA ST.,
WESTMINSTER.

TELEGRAPHIC ADDRESSES:
"HORSELEY, TIPTON."
"GALILEO, LONDON."

STEEL SCOOPS
FOR
RETORT CHARGING.

Scoops supplied with or without handles, and of any dimensions or shape required.

HENRY SYKES, Engineer,
66, BANKSIDE, LONDON, S.E.

HARPER & MOORES,
STOURBRIDGE.

MANUFACTURERS OF
BEST FIRE-BRICKS, GAS-RETORTS,
LUMPS, TILES, AND ALL ARTICLES IN FIRE-CLAY.
Proprietors of Best Glasshouse Pot, Crucible, and other Stourbridge Clays.

MANUFACTURERS OF GLASSHOUSE POTS AND CRUCIBLES OF EVERY KIND
ESTABLISHED 1836.

WILLIAM INGHAM & SONS,
Incorporated with the Leeds Fire-Clay Company, Ltd.,
WORTLEY FIRE-CLAY WORKS
Near LEEDS

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—
1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

PATENT
MACHINE-MADE GAS-RETORTS.

Gas-Bags for Mains. High-Water Boots. Woollen Miners' Jackets.

Delivery and Suction Hose, Gutta-Percha Acid Bottles, Leather Driving Bands, Woven Canvas Hose for Fire-Engines, Wedge and Square Gas-Bags, Air and Water Beds for Invalids, Oil Tarpaulin Coats, Trousers, Hats, &c., Squeegees for cleansing Pavements, &c., Billiard and Bagatelle Cush, Tricycle Tyres, Leather Hose, Cotton Waste, Engine Cloths, Oils, &c., India-rubber Waterproof Garments for Walking, Driving, or Sporting Wear, Diving and Wading Dresses, Printers' Blankets, Iron Wheels and Rollers covered with India-rubber. Stokers' Gloves, 14s. per dozen.

Write for Price List to
THOMAS BUGDEN, Manufacturer,
116 & 118, GOSWELL ROAD, LONDON, E.C.

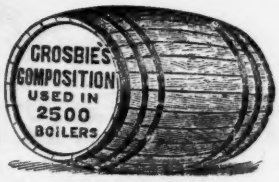
TELEGRAPHIC ADDRESS, "GAS LEEDS."
60, QUEEN VICTORIA STREET, E.C. LONDON OFFICE.
CLAYTON, SON, & Co.
LIMITED,
LEEDS,
MAKE
RETORT LIDS
OF ALL FORMS AND SHAPES
IN IRON OR STEEL
BY SPECIAL HYDRAULIC MACHINERY.
PRICES ON APPLICATION.

USED AT THE GAS-WORKS
AT
Ascot, Ballymena, Birmingham, Broadstairs, Bromsgrove, Chesterton, Hendon, Ilkeston, Kildwick, Knutsford, Leven, N.B., London, Pembroke, Seaham Harbour, Stamford, Stroud, Harwich, Uttoxeter, Wigston, Workington, &c., &c., and by Corporations and leading Engineers throughout the Country, for preventing

BOILER INCRUSTATION.

Absolutely Harmless and free from Acids.

Crosbie's Paints for Gas-Works. Economical and Durable.



ADOLPHE CROSBIE, Ld.,
Chemical Works, Wolverhampton.

The Climax of Regenerative Gas Lighting!!

THE
"VERTMARCHE"
A 280-CANDLE POWER
PLAIN IRON LAMP,
CLASS A— 55/-
LIGHT for LIGHT
less than half the price of any other Regenerative Lamp.

Manufactured in England by
HENRY GREENE & SONS,
153 & 155, CANNON STREET,
LONDON BRIDGE, E.C.
PARTICULARS AND PRICES FREE. AGENTS WANTED.

S. PONTIFEX & CO.,
GAS and WATER ENGINEERS
Manufacturers of and Contractors for the Maintenance of
PUBLIC LAMPS & LANTERNS;
GLASS—Flint, Opal, and Bent in Stock, and Cut to Sizes.
WELL LAMPS, STREET NAME TABLETS,
LAMP COLUMNS, HEAD IRONS, PUTTYLESS LAMPS.
LANTERNS COCKS, REGULATORS,
Improved High-Power Lanterns for Lighting Street Refuges and Open Spaces.

BROWN'S PATENT
LAMPLIGHTERS' TORCHES.

PROPRIETORS AND MANUFACTURERS OF
BOX'S PATENT
PUTTYLESS STREET LAMP.
This Lamp may be supplied fitted with clear opal, or ribbed glass, *as also with enamel tops* if required. The necessary fittings for altering existing Lamps to this system can be supplied at moderate prices.

S. PONTIFEX & CO., 22, COLEMAN ST., LONDON.
Works: 18, STEPHEN STREET, TOTTENHAM COURT ROAD, W.

W. PARKINSON & Co.

STOVE DEPARTMENT.

TWO GOLD MEDALS.

DERBY, 1891. WOLVERHAMPTON, 1891.

NEW

GAS-FIRES.

(Curved Fronts.)

ALL FIRES are of First-Class Finish.

The "ROYAL."
An artistic Stove suitable for Drawing-Rooms, &c., constructed with Hot-Air Tubes fitted on an improved plan. Universally admired.

The "EMPIRE."
A modification of the above specially suited for hiring out, &c.

The "BRILLIANT."
Highly finished design, powerful burner, and moderate price

The "RUBY."
Made in two sizes. Most popular Bedroom Fire now being made.

The "DOMESTIC."
Made in two sizes. Utility and elegance combined. Fitted with Boiling-Burner at top when required.

Send for Parkinson's New Stove Catalogue.

COTTAGE LANE WORKS, CITY ROAD, **LONDON.** Telegraphic Address: "INDEX."

BELL BARN ROAD WORKS, **BIRMINGHAM.** Telegraphic Address: "GAS-METERS."

OFFICE: 10, MAWSON'S CHAMBERS, DEANSGATE, **MANCHESTER.** Telegraphic Address: "PRECISION."

[See also Advt., p. 1116.

London: Printed by WALTER KING (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, Dec. 27, 1892.

[Registered as a Newspaper.

THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

Vol. LX. No. 1545. LONDON, DECEMBER 20, 1892. [44th Year. Price 6d.

O'NEILL'S OXIDE

Has the Largest Annual Sale of any Oxide in the World.

Registered Telegraphic Address:
"PURIFICATION LONDON."

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

JOHN WM. O'NEILL, *Managing Director.*

PALMERSTON BUILDINGS, LONDON, E.C.

"CALLEY'S" TORBAY PAINT.

THE TORBAY PAINT COMPANY.
(Proprietors, Stevens & Co.)
HEAD OFFICES:
26, 27, & 28, Billiter Street, LONDON, E.C.
And at 4 India Buildings, Water St., LIVERPOOL.
WORKS AND MINES:
BRIXHAM, DEVON.

W & B COWAN

SEE ADVERTISEMENT ON PAGE III. OF WRAPPER.

COWEN'S PATENT FIRE-CLAY RETORTS.
JOSEPH COWEN and CO.,
Blaydon Burn, Blaydon-on-Tyne,
Were the only parties to whom a Prize Medal was awarded at the Great Exhibition of 1851, for "Gas Retorts and other Objects in Fire-Clay;" and they were also awarded, at the International Exhibition of 1862, the Prize Medal for "Gas-Retorts, Fire-Bricks, &c., for Excellency of Quality."
J. C. & Co. have been for many years the most Extensive Manufacturers of Fire-Clay Retorts and Fire-Bricks in the Kingdom. Orders for Fire-Clay Retorts of all shapes and dimensions, and to fit any shape Mouthpiece, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above
COWEN'S GARESFIELD COALS.
Jos. Cowen and Co. are the only Manufacturers of Fire-Bricks and Clay Retorts at Blaydon Burn.

JOHN RUSSELL & CO.,
LIMITED,
Established at the Commencement of Gas Lighting,
Manufacturers of
TUBES AND FITTINGS.
THREE PRIZE MEDALS, Paris, 1878.
Head London Offices:
145, QUEEN VICTORIA STREET.
ALMA TUBE-WORKS, WALSALL.
Old Patent Tube-Works, Wednesbury.

W. PARKINSON & CO.,
GAS ENGINEERS,
LONDON & BIRMINGHAM.
See Advertisement on p. 1072.

THOMAS PIGGOTT & Co., LTD.,
BIRMINGHAM.
MAKERS OF
GASHOLDERS
AND
GAS PLANT.
LONDON OFFICE: 14, GREAT ST. THOMAS APOSTLE, E.C.

CROSSLEY'S
"OTTO" GAS-ENGINE
Crossley's Engines and Pumps
are used in all the most recent and important Towns' Water and Sewage Installations.
LATER PATENTS. MANY NEW IMPROVEMENTS.
CROSSLEY BROS., Ltd.,
OPENSHAW, MANCHESTER.

JAMES McKELVIE & CO.,
CANNEL AND GAS COAL EXPORTERS,
HAYMARKET, EDINBURGH;
and at ALBERT BUILDINGS,
49, QUEEN VICTORIA STREET, LONDON.
Prices and Analysis of all the principal
CANNEL AND GAS COALS
forwarded on Application.
SOLE AGENTS FOR THE
DUKE OF HAMILTON'S
LESMAHAGOW CANNEL COAL.
ESTABLISHED 1840.

L & L Tubes and Fittings. | **LLOYD & LLOYD,** NILE STREET, **BIRMINGHAM.** | **L & L** Tubes and Fittings.

GEORGE GLOVER & Co.

LONDON, 1862.—Class 10.

PARIS, 1867.

VIENNA, 1873.

MANCHESTER, 1875.

LONDON, 1862.—Class 31.

The Medal for Ingenuity, Completeness, and Efficiency of Apparatus for Measuring Gas, and Excellence of Material and Workmanship.

Patentees of the NATIONAL STANDARD GASOMETERS, AND MANUFACTURERS OF

Prize Medal for Superior Construction and Sound Workmanship.

IMPROVED DRY GAS-METERS.

SYDNEY, 1880. First Award, Special.

MELBOURNE, 1881. Gold Medal.

NEW ZEALAND, 1882. Gold Medal.

LONDON, 1884. Gold Medal.

LONDON, 1885. Gold Medal.

LIVERPOOL, 1886. Gold Medal.

DEWSBURY ROAD **LEEDS.** | CHELSEA, **LONDON.** | LANCASTER AVENUE, **MANCHESTER.**

Telegrams: "DRY METERS, LONDON."

THE FLOW OF GASES AND PROPORTIONING GAS MAINS—FOUR DIAGRAMS (with EXPLANATORY PAMPHLET), arranged by F. S. CRI... Price 7s. 6d., to be obtained at the JOURNAL Offices.

THE UNITED ASBESTOS CO. LIMITED.

DOCK HOUSE, BILLITER ST., LONDON, E.C.
(Late 161, QUEEN VICTORIA STREET.)

PIONEERS of the ASBESTOS Trade. The ONLY COMPANY in the WORLD owning and working Asbestos Mines both in ITALY and CANADA. All Goods are made at our Works, near London, and are of the best possible description. Specify "SALAMANDER" Brand.

DEPOTS: Newcastle-on-Tyne, Quay Side; Manchester, 34, Deansgate; Liverpool, 33, James St.; Glasgow, 68, West Howard St.; Cardiff, 135, Bute St.; St. Petersburg, Gostinoi Dvor (Interior) No. 51; Antwerp, Rue Nassau, 8.

J. & J. BRADDOCK,

GLOBE METER WORKS,

Telegrams:
"Braddock Oldham."

OLDHAM.

IMPROVED DRY METERS IN THE BEST *Tin Plate Cases.*

SUPERIOR — CONSTRUCTION.

UNEQUALLED FOR GENERAL EXCELLENCE.

STOCK KEPT.

WET METERS.

Telegrams: "Whessoe Darlington."

London Office: 25, Queen St., E.C.

THE WHESSOE FOUNDRY COMPANY LIMITED, DARLINGTON.

SUPPLY GAS PLANT OF EVERY DESCRIPTION FROM RETORT TO GASHOLDER, INCLUDING BENCH MOUNTINGS, CONDENSERS, EXHAUSTERS, SCRUBBERS, PURIFIERS, GASHOLDERS AND TANKS.

MR. THOS. COATES, C.E., MANAGING-DIRECTOR.

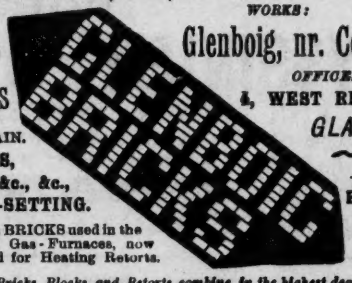
ENGINEERS & CONTRACTORS.

Established 1790.

Estimates on Application.

THE GLENBOIG UNION FIRE-CLAY Co. Ltd.

THE LARGEST MANUFACTURERS OF GAS-RETORTS IN GREAT BRITAIN. FIRE-BRICKS, BLOCKS, &c., &c., for RETORT-SETTING.



WORKS: Glenboig, nr. Coatbridge.

OFFICES: 4, WEST REGENT ST., GLASGOW.

— 33 — Prize Medals.

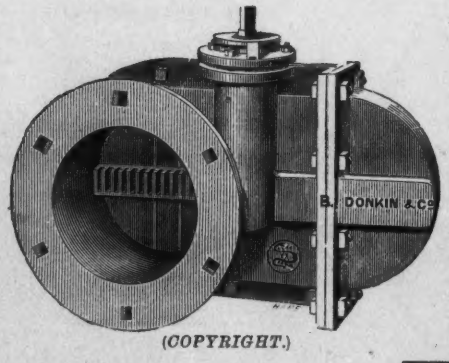
Highest Award wherever Exhibited.

The SPECIAL BRICKS used in the Construction of Gas-Furnaces, now being introduced for Heating Retorts.

The Glenboig Bricks, Blocks, and Retorts combine, in the highest degree, the qualities of not melting, and not splitting, when subjected to the highest heats and most sudden changes of temperature, and are, in consequence, found to be economical, even in districts where the local bricks can be had at half the price.

"THE DONKIN GAS-VALVE."

(REGISTERED TRADE MARK.)



(COPYRIGHT.)

We are the Sole Makers of these Valves, fitted (for size above 5 inches) with our patented application of Volute or Spiral Springs. With these the breaking of springs is almost an impossibility, and any jamming of the valve from the pieces quite an impossibility.

Over 15,000 applications of these Springs have been made.

Very special attention is paid to the Testing, in order that Gas Managers may have perfect reliance upon the tightness of our Valves, when leaving our Works; and, where wished, we are prepared to test them with foul gas.

Over 1200 Valves always in stock to insure quick deliveries.

BRYAN DONKIN & Co., LIMITED,

SOUTHWARK PARK ROAD, BERMONDSEY, LONDON.

Also Makers of COLUMN and SCREW VALVES, and Sole Licensees of J. BEALE'S NEW PATENT EXHAUSTER.

MANCHESTER OFFICE: HENRY THOMAS, 10, MAWSON'S CHAMBERS, DEANSGATE.

The Best Gas Apparatus In the Market.

GASHOLDERS on the Rope System
SCRUBBERS with Green's Screens
SULPHATE PLANT, new design

Have never failed to give satisfaction.

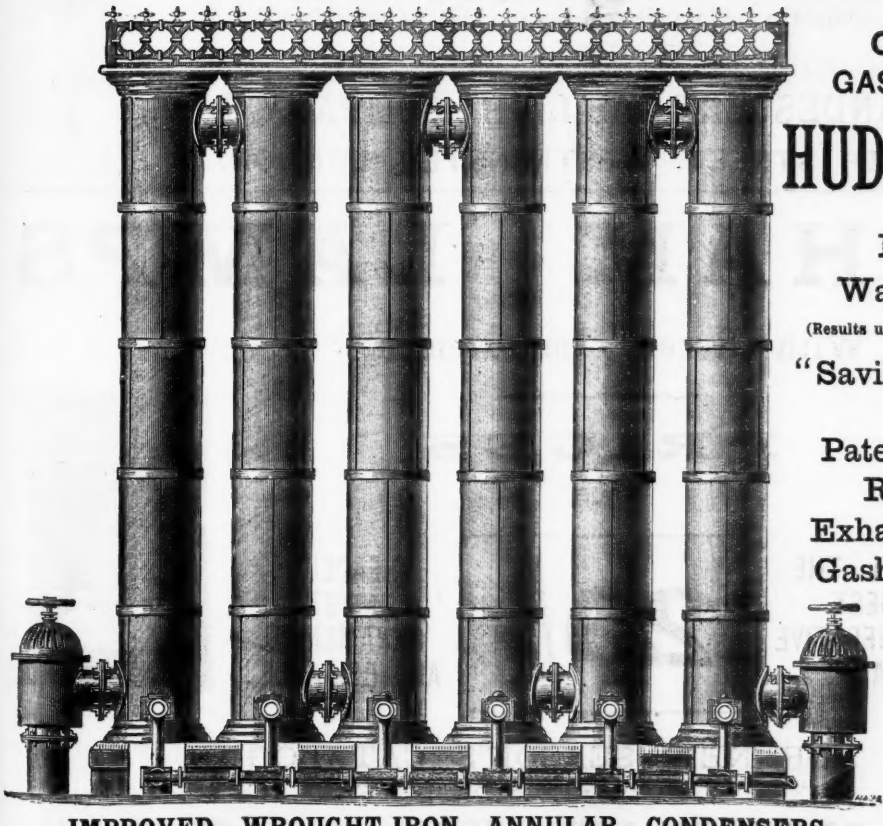
THE WORKING AND ECONOMY OF THESE WILL WELL REPAY INVESTIGATION.

EVERYTHING REQUIRED TO MAKE A GAS-WORKS COMPLETE IS MANUFACTURED BY

Ashmore, Benson, Pease, & Co., LIMITED,

STOCKTON-ON-TEES.

W. C. HOLMES & Co.,



IMPROVED WROUGHT-IRON ANNULAR CONDENSERS, WITH WING VALVES TO REGULATE THE CONDENSING POWER.

CONTRACTING GAS ENGINEERS,

HUDDERSFIELD.

Patent Rotary Washer-Scrubbers
(Results unapproached by any other System),
"Saville's" Patent Tar Extractors,
Patent Regenerative Retort-Settings,
Exhausters, Purifiers,
Gasholders (any size),
Valves, and
All Requisites
FOR
Gas-Works.

Telegrams: "Holmes Huddersfield."

GAS ENGINES

THE KILMARNOCK "GRIFFIN."

SINGLE AND DOUBLE ACTING. ALL SIZES FROM ¼ HP. UP TO 250 HP.
LATEST TYPE HAS ALL THE MOST RECENT IMPROVEMENTS.

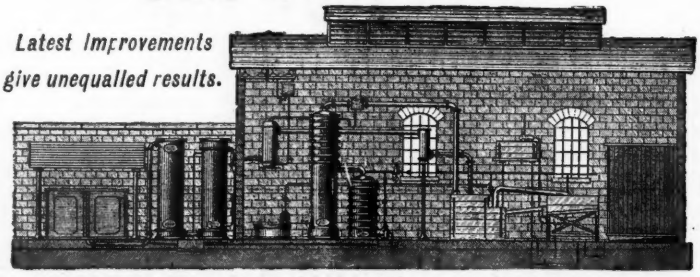
DICK, KERR, & CO., Ltd., 161, LEADENHALL STREET, LONDON, E.C. BRITANNIA WORKS, KILMARNOCK.

MAURICE SCHWAB, MANCHESTER,

96, DEANSGATE,
GAS ENGINEER.

Sole Licensee of WILTON'S PATENT SULPHATE OF AMMONIA DISCHARGER.
OVER 50 APPARATUS WORKING.

Latest Improvements give unequalled results.



SULPHATE OF AMMONIA APPARATUS OF THE MOST MODERN CONSTRUCTION.
REFERENCES, &c., ON APPLICATION.

Gas-Making Apparatus & General Contract Work, in Cast & Wrought Iron & in Lead, supplied and erected in any part of the United Kingdom.
Before ordering elsewhere, please write for an Estimate.

A 50-CANDLE POWER LIGHT WITH 3 CUBIC FEET OF GAS

CAN BE OBTAINED BY

THE INCANDESCENT GAS-LIGHT (NEW SYSTEM)

STEADY, CLEAN, AND BRILLIANT LIGHT.
CAN BE USED WITH ORDINARY GAS-FITTINGS.

Professor CARLTON LAMBERT has pronounced this to be the cheapest form of Illuminant, and one that gives a light **equal to the Incandescent Electric Light at one-eighth the cost.**

"A" Lamp
50-Candle Power.

FOR PRICES AND PARTICULARS, APPLY TO

THE INCANDESCENT GAS-LIGHT COMPANY, LTD.,
PALMER STREET, WESTMINSTER, LONDON.

"B" Lamp
80-Candle Power

WENHAM LAMPS

With Recent Improvements.

PRICES

FROM

STILL THE BEST REGENERATIVE LAMP.

20/-

CHEAPEST! MOST ORNAMENTAL AND RELIABLE!

APPLY FOR NEW SEASON'S CATALOGUE.

THE WENHAM COMPANY, LTD. UPPER OGLE STREET, LONDON, W.

A REVOLUTION IN CONVEYORS AND ELEVATORS.

OUR LEADING SPECIALITIES ARE

Little's Patent Noiseless

WIRE-ROPE

PUSH-PLATE and TRAY CONVEYORS and ELEVATORS

For Coal, Coke, Lime, Oxides, and Ashes.

AUTOMATIC RETORT-HOUSES.

AUTOMATIC COAL-STORES.

WE ALSO MAKE

Coal Hoppers, Tanks, Travelling-Shoots, Rails, Coal-Breakers, Pan-Mills, and General Accessories.

PLEASE APPLY FOR DETAILS TO THE

NEW CONVEYOR COMPANY, LTD.

3 & 4, LIME STREET SQUARE, LONDON, E.C.

Sulphate of Ammonia.

DR. FELDMANN'S PATENT APPARATUS.

By special agreement with Dr. A. FELDMANN, we have secured **THE SOLE RIGHT** to manufacture his successful apparatus in the United Kingdom. Special attention is invited to a **NEW IMPROVED STILL** devised by him, which is unusually compact, efficient, easily cleaned, and economical in working.

Particulars and Prices on application.

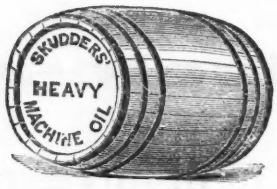
SAML. CUTLER & SONS,

MILLWALL, LONDON.

EVERY REQUIREMENT FOR GAS-WORKS SUPPLIED.

G. SKUDDER & CO.,

Telegraphic Address: "SKUDDER LONDON." **98, TOOLEY STREET, LONDON, S.E.** Telephone No. 4899.



SAMPLES FREE.

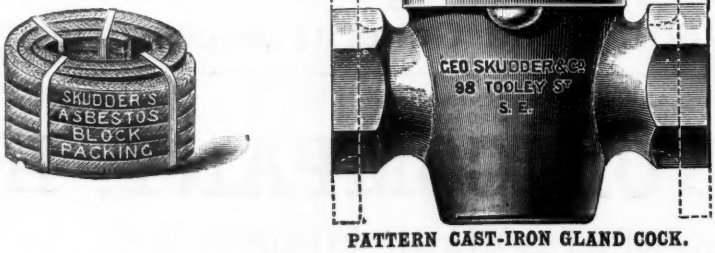
SAMPLES FREE.

These Oils are supplied to all the leading Gas Companies in London, and can be relied upon.

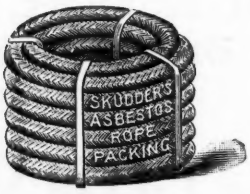
SKUDDER'S MASSIVE

ASBESTOS PACKING.
ASBESTOS SHEETING.
ASBESTOS MILLBOARD.

RUBBER INSERTION.
RUBBER SHEETING.
RUBBER CEMENT.



PATTERN CAST-IRON GLAND COCK.



All Asbestos Goods, Leather Belting, Cotton Waste, Engine Packing, &c., kept in Stock.

THE "METEOR" HIGH-POWER GAS-LAMP.

Class B.

The Electric Light's greatest Rival. Has been awarded 8 Gold and Silver Medals.

For inside, and outdoor Lighting.

THE "METEOR" LAMP IS

The cheapest
The simplest
The most economic
The most durable
The most brilliant
The best ventilating
The most easily cleaned

} **Lamp in Existence.**

The best and most suitable Lamp for hiring and hire-purchase. Being made entirely of fine Cast-Iron, the "Meteor" is practically indestructible. Greatly reduced prices. Liberal terms. Write for new descriptive reduced price list.

N.B.—Accessories are now offered at greatly reduced prices.

W. J. MOORE,

Sole Manufacturer's Representative,

83, UPPER THAMES STREET, LONDON, E.C.

HANNA, DONALD, & WILSON,

(Established 1851),

GAS ENGINEERS & CONTRACTORS,

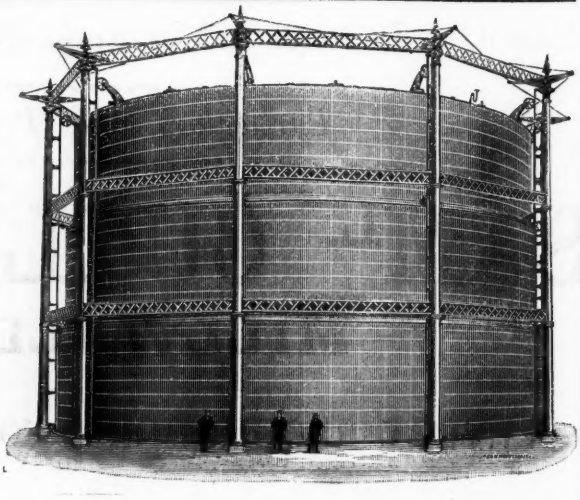
Abercorn Foundry and Abbey Works,

PAISLEY, N.B.,

MAKERS OF

Gasholders and Gas Plant

OF EVERY DESCRIPTION.



Telegraphic Address: "Donald Paisley."

W. & B. COWAN'S DRY METERS.

These, which are made at our Factories in London, Manchester, and Edinburgh, are constructed of the best charcoal double tinned plates, and the diaphragms of the best Persian sheepskins specially selected and prepared. The diaphragm is tied with Bessemer steel wire, between which and the leather a band of flax webbing is interposed, so as to protect the latter. By this means leakage at the tying is rendered impossible.

Leakage at the index-box is effectually prevented by the adoption of a grease-cup in connection with the ordinary stuffing-box. A prolonged experience of this modification, which we introduced in 1878, justifies its recommendation as a substantial improvement.

Excepting as regards the cases, the above remarks apply equally to our cast-iron cased Dry Meters, which are found very useful for certain special purposes.

All the sizes of these Meters are of neat design, and are unexcelled for workmanship, material, and finish. The most careful supervision is exercised at every stage of their manufacture, and only the highest class of skilled labour is employed.

Meter in Tinplate Case.

Meter in Cast-Iron Case.

Large Stocks always Ready for Immediate Delivery or for Shipment.

W. & B. COWAN,

ESTABLISHED 1827

SMITH SQUARE WORKS, WESTMINSTER, **LONDON, S.W.** TELEPHONE No. 3230. "DISC LONDON."

DUTTON STREET WORKS, **MANCHESTER.** TELEPHONE No. 1543.

BUCCLEUCH STREET WORKS, **EDINBURGH.** TELEPHONE No. 732.

TELEGRAPHIC ADDRESSES: "DISC MANCHESTER." "DISC EDINBURGH."

GAS-METERS.

THE GAS-METER COMPANY, LTD.,

Manufacturers of Patent

Wet and Dry Gas-Meters, Station Meters, Governors, Gas Apparatus, &c.

WORKS: LONDON, OLDHAM, DUBLIN.

CROLL'S PATENT IMPROVED DRY GAS-METER

Has stood the test of years.

The COMPENSATING WET METER, on Sanders and Donovan's Principle, for Simplicity of Action and Correct Registration cannot be surpassed.

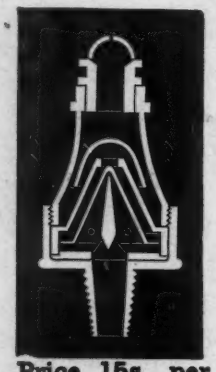
IMPROVED WET METERS IN CAST-IRON CASES.

VALON'S PATENT PREPAYMENT METER.

Accuracy. Best Materials. First-Class Workmanship Guaranteed.

For Prices and Particulars apply to

R. L. ANDREWS, General Manager, 238, KINGSLAND ROAD, LONDON.



Price 15s. per dozen.

PALACE, MANSION, OR COTTAGE.

THE WORLD-FAMED

PEEBLES' NEEDLE BURNER

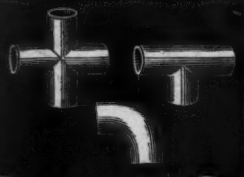
Effectually Controls Excessive Gas Pressure, and is suitable for all.

SILENT, STEADY, ECONOMICAL.

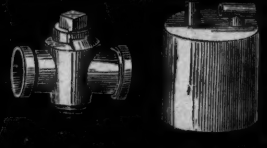
THE LIGHT BRIGHT AND BEAUTIFUL.

LONDON WHOLESALE AGENTS: Messrs. HODGE & CO., 100, Hatton Garden; HULETT & CO., 55, High Holborn; EVERED & CO., 28, Drury Lane; and 50, Holborn Viaduct; MILNE, SONS, & MACFIE, 60, Holborn Viaduct, E.C.

PEEBLES & CO., TAY WORKS, BONNINGTON, EDINBURGH.



TUBES



TUBES AND FITTINGS IN ALL SIZES AND OF ALL DESCRIPTIONS

JOSEPH · AIRD

TUBE-WORKS - GREAT-BRIDGE STAFFORDSHIRE

LONDON OFFICE 46 QUEEN VICTORIA STREET E.C.

MANUFACTURERS OF

IRON TUBES AND FITTINGS

TO H.M. GOVERNMENT.

CONTRACTORS FOR THE SUPPLY OF

GAS-METERS & STREET-LAMPS

STREET-LAMP GOVERNORS, &c.

D. HULETT & CO., Ltd.,

55 & 56, HIGH HOLBORN, LONDON.

London: Printed by Walter King (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square): and published by him at 11, Bolt Court, Fleet Street, in the City of London — Tuesday, Dec. 20, 1892.